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**CLINICAL RESEARCH IN UNITED STATES ARMY BASE
HOSPITAL**

BY MAJOR GENERAL WILLIAM C GORGAS

Surgeon-General, U S Army

September 30, 1918

CLINICAL investigation in our Army Hospitals under war conditions is worthy of encouragement whenever and wherever it does not interfere with specific military duties and the care of the sick and wounded. Fortunately, it nearly always happens that the man who has the knowledge and the ability necessary to pursue scientific work is just the man who will not permit its allurements and rewards to stand in the way of his plain duty in hospitals. The Medical Department of the United States Army has always been friendly to scientific investigation from the days of William Beaumont down, but in the military scheme of things it neither should nor would be permissible to encourage even work of this kind if at the expense of the great obligations which press on us from every side, and which must, in the nature of things, have the foremost place. In times of stress, for example, during the outbreak of an epidemic disease in camp or when a Base Hospital is overcrowded with wounded soldiers awaiting bed-space and treatment, conditions are such that no self respecting medical officer would neglect the first requirements of his calling for any consideration whatever. But there are sometimes long, humdrum, even tedious stretches in Base Hospital life, when everything is running smoothly, when the wards are half-empty, and nothing in particular happens. It is then, when the medical officer who is fitted for the task may, and sometimes does, employ

his time profitably in running over his medical or surgical cases, with a view to utilizing them for some scientific purpose. As to the ideal of excellence which may be compassed in such clinical work, that has been set for us in the stirring address which Sir William Osler delivered to the graduates of the Army Medical School in 1894.

"The clientèle in which you work has, however, more stability, a less extended range of variation than that with which we deal in civil life. In a body of carefully selected active young men you have a material for study in which the oscillations are less striking, and in which the results of the experiments, *i. e.*, the diseases, have a greater uniformity than in infancy and old age, in the enfeebled and debauched. This adds *a value to the studies of army medical officers* so trustworthy and thorough that they serve us as a standard of comparison, as a sort of abscissa or base-line. Thus you have demonstrated to us, and to the community at large, the possibilities of stamping out smallpox by systematic revaccination, in civil practice we strive to reach the low rate of mortality of army hospitals in the treatment of typhoid fever and of pneumonia. Many of the most important facts relating to etiology and symptomatology have come from camp or barrack. I often think that army surgeons scarcely appreciate that in their work they may follow the natural history of a disease under the most favorable circumstances, the experiments are more ideal, the conditions less disturbing than those which prevail either in family practice or in the routine of the general hospital. Many of the common disorders can be traced from inception to close as can be done in no other line of medical work, and the facilities for the continuous study of certain affections are unequalled. This, which is a point to be appreciated in the intrinsic education of which I spoke, gives you a decided advantage over your less favored brethren.

"Your extraordinary range of observation, from the Florida Keys to Montana, from Maine to Southern California, affords unequalled facilities for the study of many of the vexed problems in medicine—facilities, indeed, which in the diversity or

morbid conditions to be studied are equalled in no position in civil life "

This volume is a new departure in the matter of publications by Army Medical Officers of the Army in war time. Since the declaration of war, and particularly since our Base Hospitals have been going concerns, our funds for printing have been small and we have had to rely upon the medical journals of the country as repositories for our publications. The "Military Surgeon" is entirely devoted to this end, and some of our leading medical weeklies and monthlies have generously set apart a special section of their contents for contributions on "Military Medicine and Surgery." The present volume is the first attempt to publish a large collection of clinical material from our Base Hospitals in block and in bulk. Aside from its face value to the physician, a collection of this kind possesses an additional prospective value to our medical establishment, in connection with the projected Medical History of our participation in the present war.

In England the idea of "interim publications," that is, preliminary communications on some of the leading themes of such a history, has been freely encouraged from the very beginning of the war. In accordance with the proviso of Section 16 of the National Insurance Act of 1911 (Great Britain), a Medical Research Fund, consisting of "an annual sum calculated at the rate of one penny in respect of each insured person in the United Kingdom, payable out of monye sprovided by Parliament," was set aside for purposes of scientific investigation in medicine. Under the statutory rules formulated in 1914 this Medical Research Committee consists of nine persons appointed for three years to prepare schemes for research, with estimates of expenditure, which have to be approved by the National Health Insurance Joint Committee after conference with an Advisory Council for Research, also appointed for three years. In 1913-14 the sum available for this purpose amounted to about £55,000 (\$275,000). This fund, which under ordinary circumstances would have increased slightly from year to year, in proportion to the natural growth of the population and the

increase in number of insured persons, was found to diminish, after the outbreak of the war, owing to the enlistment of insured persons in the British Army. On March 25, 1914, the Committee contracted to purchase the Mount Vernon Hospital building at Hampstead, with its freehold site and grounds, as a Central Research Institute. At the outbreak of the war this building was placed at the disposal of the War Office, and became the Hampstead Military Hospital, the laboratory work in applied physiology, bacteriology, biochemistry, etc., being carried forward in other hospitals and institutions. Work in connection with the war was begun at once both at the Hampstead Hospital and in the other scientific departments. It included investigations on army medical statistics and records, pathology, wound treatment, internal medicine and neurology, industrial fatigue, and the health of munition workers, in fact, all the phases of military medicine which had become of outstanding importance from the time of the retreat of Mons and the battle of the Marne. These investigations, variously published in the British Medical Journal, Lancet, Journal of the Royal Army Medical Corps, etc., have latterly been summarized, for the most part, in the valuable series of special Reports of the Medical Research Committee. This indicates the probable line which we shall have to take if our participation in the present war should, as with our Allies, cover several years. First, continuous and liberal publication of our scientific material in the medical periodicals, second, digests of large amounts of material (including laboratory work) in the form of serial monographs, third, final assimilation of all this material in the definitive volumes of the history itself. In this way only can large amounts of our scientific material be handled as we go on, and before we are swamped with the whole mass of it. Here we are only profiting by the experience of Great Britain, as set forth in the following paragraph of Sir Walter Morley Fletcher, Secretary of the English Medical Research Committee:

"I think these principles we suggested at the beginning were sound, and I think we can claim that they have been wholly justified by experience. An immense volume of work in all

these subjects has been done, and much of it has been published already. These interim publications have brought immediate aid by information to the present workers. They do not in the least (as some were inclined to fear) detract by anticipation from the value of the future Medical History, while, as I think, they have provided a chief condition for its success. These interim publications cannot damage the Medical History, for the value of the History will consist in its combination of all the fragments in a regular architecture."

From the experience of our British allies, which now covers a period of four years, and using the end result of this organization as our point of departure, we shall, as the war goes on, have to deal with the problem of finding funds for serial publications of laboratory and clinical investigations of large dimensions. For the present we shall have to rely upon the patriotic spirit and friendly assistance of the editors of periodicals devoted exclusively to scientific medicine and of publishers of well-established serials of the present kind. The advantage of scientific publications in serial form over the ordinary periodical form is that they are not limited by the condition of periodicity, in other words, they need not be issued until a sufficient amount of worthy material has accumulated. The Monographs issued at indefinite intervals by the Rockefeller Institute afford a good example of this species of medical serial. Its success is conditioned in part by the fact that production and publication are not hampered by the ordinary time-limits. There are few medical serials of this kind in the United States, but we shall feel the need for them more and more. Our younger school of scientific physicians is doing good work, and their number will increase.

As to the Base Hospitals themselves, they demonstrate, among other things, the teaching value of medical war history, being "almost exact replicas of structures erected in this country during another war over half a century ago," and described in the Medical and Surgical History of the Civil War.¹ At the outbreak of the Civil War both Federal and Confederate

¹ Wood Military Surgeon Washington 1918, xlii 539-41

forces found themselves confronted by the large problem of providing immediate shelter and treatment for thousands of sick and wounded soldiers. The military authorities on both sides were obliged to commandeer and use almost any buildings available in any particular neighborhood. First tents and dwelling houses, later hotels, churches, factories, warehouses, schools, colleges, and other municipal structures were freely employed, and barrack buildings were also reconstructed for this purpose. In Washington, D C, the National Hotel (1861), Georgetown College, Odd Fellows Hall, and many churches were speedily converted into extempore hospitals, in Alexandria, Va, the old Hallowell House, the Bell Haven Institute, the Methodist Church, the Fairfax Theological Seminary, in Baltimore, the National Hotel, at Annapolis, the Naval Academy¹. On the Confederate side, we find the same state of affairs. At Corinth, Mississippi, the Tishomingo Hotel and other buildings, at Gulf Port, Mississippi, a large planter's residence, with kitchen and out-houses, a church at Chattanooga, at Macon, Ga, a former school for the blind, at Kingston, Ga, a number of old stores, at Atlanta churches and stores all over the city were used as hospitals². As the wounded poured in from the great battles there came the need for expansion, and thus additional structures for wards came to be grouped around the original building or buildings. This was the origin of the modern Base Hospital. In the neighborhood of large camps, near the bases of supplies and the line of communications, it became expedient to run up groups of ridge-ventilated wooden pavilions of one story each, tactically arranged in various geometric figures around a central administration building, and connected by covered passageways. The first of these was the large wooden hospital erected at Parkersburg, Va, in 1862, which was divided by wooden partitions into four wards of twenty beds each. This was followed by hospitals of similar plan and ventilation at New Kirk, Va, Gallipolis, Ohio, and Clarysville, Md. Then came

¹ Medical and Surgical History of the War, Washington (Medical History), 1888, III, 896-966

² Kate Cumming A Journal of Hospital Life in the Confederate Army of Tennessee, Louisville, Ky, 1866

the large communal pavilions, such as the Satterlee Hospital at West Philadelphia (3519 beds), with fourteen parallel pavilions projected from each of the corridors, the V-shaped Lincoln and Harewood Hospitals at Washington, D C, with the wards arranged *en echelon*, the Mower Hospital at Chestnut Hill, Philadelphia (3100 beds), a rounded quadrangle of fifty pavilions, enclosing the administration building, and the semicircular Hicks Hospital, at Baltimore, Md. The larger hospitals of the Confederacy, such as the Chmborazo at Richmond, the Newsum (Chattanooga), the Bragg Hospital (Ringgold, Ga.), and the General Hospital at Okolona, Miss., followed the same trend of expansion.

Our present Base Hospitals are usually quadrangular arrangements of single-storied wooden pavilions, of the same type as those of the Civil War period, connected by covered corridors, with a compact administration building at the center of one side of the quadrangle, and isolation wards, convalescent pavilions (two stories), quarters for officers and enlisted men, and other necessary buildings, as outhouses. These hospitals were, unfortunately, the last things to be put up when the camps were organized and the cantonments built, so that the unprecedented and wholly unexpected severity of the winter of 1917-18 had its bad effects upon the infectious diseases which broke out in camp. But we have already profited by experience to the extent that we are now fully equipped and able to cope with any epidemic diseases that may attack the newer and later drafts. In medical and surgical personnel, in laboratory facilities and equipment, these hospitals are abreast of any hospitals in civil life.

The Laboratory Service of our Army Medical Department is fully adequate to deal with any scientific problems which may come up, and already includes three special laboratories for investigating the pathology of gas-poisoning and one for disorders of respiration in aviators. A number of scientific studies from these laboratories are awaiting publication. The present volume of clinical contributions is typical of much of the work which has been produced in the Medical and Surgical Sections of the various cantonment Base Hospitals in this country.

A STUDY OF THE EPIDEMICS OF PNEUMOCOCCUS AND STREPTOCOCCUS INFECTIONS, AND MEASLES, AT CAMP ZACHARY TAYLOR, KENTUCKY, AUTUMN, 1917, TO SUMMER, 1918¹

BY MAJOR WALTER W HAMBURGER, M C (Chicago), and
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I INTRODUCTION

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- B. Definition of Terms.
- C. Acknowledgment to Associates.

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Second period November and December 1917, January, 1918. First measles and measles pneumonia period

Third period December 1917 January and February, 1918. Streptococcus, atypical pneumonia, and pleuritis period

Fourth period Second measles, measles pneumonia, and streptococcus period March and April, 1918 May 1918

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B DISCUSSION

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Regimental infirmaries,
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Hospital { Receiving ward,
General medical and surgical wards,
Hospital personnel

V CLINICAL PICTURE

Pneumonitis,
Pleuritis,
Measles,
Streptococcus disease.

¹ From the Medical and Laboratory Services, Base Hospital, Camp Zachary Taylor Ky

VI METHODS ADOPTED TO CONTROL THE EPIDEMICS

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Hospital	{ Medical treatment, Routine service orders, Withdrawal of fluid, Surgical treatment—time of election for surgical interference, Diet, x-Ray, Convalescence—disposition

VII RECOMMENDED MEASURES FOR FUTURE CONTROL

Camp	{ Separation of immunes and non-immunes, Separation of streptococcus carriers and non-carriers, Prophylactic vaccination—pneumococcus and streptococcus, Instruction in personal hygiene and methods of spread and preven- tion of communicable diseases, Postponement of infections by control of fatigue and exposure during acclimatization
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Hospital Segregation of carriers and non-carriers

VIII SUMMARY AND CONCLUSIONS

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I. INTRODUCTION

A Statement of Problems—Many of the thirty-two cantonments distributed throughout the country were visited and revisited with epidemics of respiratory disease, notably diseases by either pneumococcus, measles, or streptococcus, during the first year of the mobilization and training of the young men of the nation for war. These various epidemics occurred and recurred in waves of increasing and decreasing morbidity and mortality, in fact, at certain times during the winter it seemed as if the entire country was in the clutch of a pandemic of disease. At the crest of these disease waves, when one was directly in the midst of the epidemic, giving his thought and time to the saving of life, a perspective of the whole could not be clearly obtained, for, at the outset, the knowledge that an epidemic was in progress and the type of that epidemic was not in the least appreciated, and not until weeks later, until information gradually sifted in from other camps, did the real truth of

the matter appear. It would, therefore, seem profitable to analyze and evaluate the experience and data of the past winter, at least so far as camp and hospital epidemiologic conditions are concerned, in order that the lessons learned thereby may be applied to the solving of similar problems, which may reasonably be expected to recur this winter.

In retrospect, the problem of last winter's epidemics may be said to be composed of three variables: pneumococcus disease, measles, and streptococcus disease, and the solution of this problem would seem to lie in an analysis of their several mutual relations and interrelations. For example, it is of importance to appreciate the etiologic and pathogenetic relationship of pneumococcus and streptococcus, of measles and streptococcus, of measles and pneumococcus, in order that adequate epidemiologic measures may be instituted, intelligent prophylactic steps taken, and morbidity and mortality cut down. It shall be the purpose, therefore, of this study to analyze the development and history of these epidemics, and to define as far as possible the importance and relative value of the several components.

B Definition of Terms—*Epidemic*—As will be shown later, these epidemics consisted of varying waves of increased and decreased disease incidence. As used in this study, the eleven months period, from September 1, 1917, to August 1, 1918, is considered as the entire epidemic, the waves of increase and decrease are spoken of as periods of the whole.

Pleuritis (Empyema)—This usually connotes an acute purulent pleuritis, and is so used in this study. However, it has become increasingly clear that so-called empyema is simply the end-stage of an acute inflammation of the pleura, which in inflammation starts as acute fibrinous pleuritis, and progresses through the stages of serofibrinous, seropurulent, to purulent. Some cases begin as pus, but generally all are the same. Thus the type of fluid obtained at any one time depends on the stage of the disease at which the diagnosis is established.

Pneumonitis (Pneumonia)—In this study it has often been difficult if not impossible to distinguish, clinically, between

lobar and lobular pneumonia Even at the necropsy table one found great difficulty in deciding if the cases were a true lobar pneumonia or pseudolobar pneumonia, from a fused lobular process In view of this difficulty, as well as the wide variance of even the most typical lobar pneumonia from the classical well-defined picture, we have preferred to use the term "pneumonitis" in describing an acute inflammatory disease of the lung tissue

Measles—The majority of the cases were frank measles, but there has doubtless crept in a number of cases of German measles, as well as a smaller group of doubtful exanthemata, which were possibly a variation of measles or German measles, a double infection, or a recurring infection of the same disease For example, several cases beginning as typical German measles, with a fine diffuse, rose-colored rash, enlarged cervical lymph-nodes, and leukopenia developed on the fourth or fifth day a conjunctivitis, Koplik spots, bronchitis, and a red discrete, macular eruption, other cases of frank measles developed within a few weeks a second attack of the same, still others of typical German measles developed within a few weeks a second attack of that disease

C *Acknowledgments*—It is a pleasure to express appreciation and acknowledgment to Colonel Will L Pyles, M C, Commanding Officer of the Hospital, whose constant sympathy and support were of greatest value Thanks are also given for the loyal and earnest co-operation of Captain Lawrence H Mayers, M C, for the preparation of some of the charts, Lieut Morris H Kahn, M C, for some of the curves, Lieut Ralph C Sullivan, M C, for analysis of pneumonia and empyema charts, Captain Fred Sprague, M C, for radiographic work, Captain H J Everett and Lieut M S Bloom for medical statistics, Lieut Baldwin Lucke for the pathologic work and special laboratory investigation on streptococcus, Sergeants Michel, Roth, Seiler, Rogers, and Ecker for compiling statistics, stenographic and photographic work

II. EPIDEMIOLOGY

A Chronologic Development of the Epidemics — (See Charts I, II, III, and V for course and periods)

First Period September October and November, 1917 Lobar Pneumonia Period

Number of cases	49
Mortality	4
Percentage of mortality	8.8

Type Pneumococcus

Number of cases Type I	4
Number of cases Type II	3
Number of cases Type III	0
Number of cases Type IV	11
Total number of cases typed	18

Deaths

Cases Type II	1
Cases Type IV	1
Empyema	4

These early cases of pneumonia were, in general, frank cases of lobar pneumonia, starting in abruptly with chill and temperature, rusty sputum, frank pulmonary consolidation, without complications, and benign in type. Owing to the lack of proper hospital facilities, nurses, equipment, etc., the majority of these cases were treated in the wards of the Louisville City Hospital. Type determinations could be made in but few, and Type I serum was used in only a few of the Type I cases.

Second Period November and December 1917 and January 1918 First Measles and Measles Pneumonitis Period

Number of cases measles	967
Number of cases measles pneumonia	80
Mortality, measles pneumonia	18
Percentage of mortality measles pneumonia	19.4
Empyema following measles pneumonia	18
Mortality empyema following measles pneumonia	6
Percentage of mortality empyema following measles pneumonia.	33.33

This first measles epidemic reached its height at the end of November, approximately a month after the first three increments of drafted troops had come into camp. In general,

it may be said that this epidemic of measles was quite severe, the majority of patients being acutely ill from the start. The soldiers who later developed pneumonia and empyema were particularly prostrated upon entrance, with flushed face, dusky cyanosis, full bounding pulse, labored, grunting dyspnea, etc. With the development of pneumonitis, respirations were usually increased. The cyanosis was most striking, as one could almost tell from the color of the patient, on entrance, that he

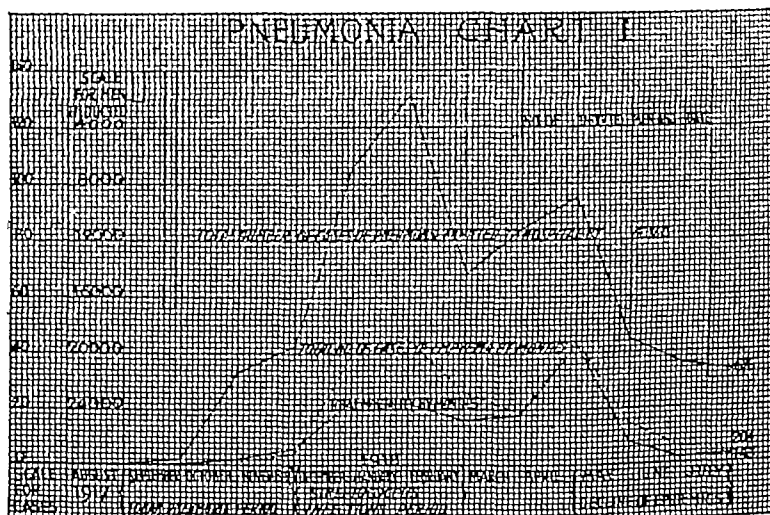


Fig 58—Empyema Pneumonia Chart I. Note sustained rise in mortality up to April, 1918, in spite of improved methods of treatment, with prompt fall in May, June, and July, notwithstanding repeated large increments of drafted men, and without change in methods of prophylaxis or treatment.

was to develop or was already developing an acute pneumonia. The type of pneumonia varied, although in most instances it was grouped as a diffuse lobular or bronchopneumonia. Physical examinations of the chest revealed diffuse scattered areas of consolidation, roughened bronchovesicular breathing, large and fine moist râles. Lieut Lucke has analyzed the post-mortem findings of these measles bronchopneumonias and has found that 9 of 16 cases group themselves into what he calls

type 1 A and 1 B In type 1-A the lungs are largely expanded and very heavy, containing small ill-defined areas of depression and elevation On palpation innumerable small firm areas are felt throughout all lobes, which on cut surface appear as numberless rounded, light grayish red, definitely raised, firm areas, appearing very much like large gray milary tubercles This type of bronchopneumonia is probably similar to the interstitial bronchopneumonia of MacCallum Type 1-B is simply a later stage of the preceding process, the various anatomic changes being more accentuated The nodules palpated are larger than in the preceding type, are quite firm, and of a grayish color

Third Period December 1917 January and February, 1918 Streptococcus, Atypical Pneumonitis, and Pleuritis Period

Number of cases of pneumonia	305
Total mortality of pneumonia	41
Percentage of mortality	13.4
Number of empyemas	110
Total mortality of empyemas	23
Percentage of mortality	20.9

Number of cases lobar and lobular pneumonia (without measles pneumonia)	245
Mortality	26
Percentage of mortality	10.6

Number of empyema lobar lobular, and primary pneumonia (without measles)	92
Mortality	17
Percentage of mortality	18.6

Of greatest interest in this series of cases was the ~~rapid and~~ extensive development of empyema and the presence of hemolytic streptococci in the pleural exudate Patients ~~entered the~~ hospital with their chests entirely full of pus, or ~~developed it~~ so rapidly after coming in that it seemed as if the empyema process was the major clinical feature of the case While in many of the cases pneumonia undoubtedly ~~existed~~, it was most difficult to diagnose, and was ~~undoubtedly~~ of minor importance The cases of so-called ~~primary empyema~~ were those

in which neither clinically nor at autopsy was there any convincing proof of a pneumonic process. The rapid development of the pleural pus could be demonstrated by the use of x ray plates to occur well within twenty-four hours. In the same way that increasing cyanosis suggested beginning bronchopneumonia in the measles cases, marked prostration, severe chest pain, labored, grunting respiration usually indicated a beginning suppurative pleuritis. With the actual development of pus, resulting in a separation of the parietal and visceral surfaces of the pleura, the intensity of the chest pain diminished until the patient was in comparative comfort.

The pleural fluid in a very large percentage of these cases showed streptococci, although pneumococci were also present. The bacteriologic findings at this period were as follows:

Fluids showing hemolytic streptococci	63
Fluids showing pneumococci	26
Undetermined	15
Sterile	6

The infecting organisms of the fatal cases

Hemolytic streptococcus	21
Pneumococcus	12
Undetermined	7
Sterile	0

The above shows conclusively the predominance of the streptococcus. Stained smears from this fluid showed countless numbers of short and long chains of streptococci.

In many of these cases the first exploratory aspiration revealed a thin, straw-yellow, serofibrinous exudate, which as the case progressed became constantly thicker and more purulent, until finally thick greenish-gray creamy pus was obtained. This change in the consistency of the pleural fluid will be referred to later in the discussion of treatment, as it was demonstrated quite early that surgical interference was of most value when delayed until this "creamy" or "purée" stage of the exudate had been reached.

The physical signs of these cases were most interesting and misleading, it being quite impossible in many instances to differentiate between a consolidation and a chest full of fluid. After considerable experience it was found that dulness to flatness on percussion and diminished tactile fremitus were the two signs upon which most reliance could be placed. However, a positive chest puncture, or positive evidence of fluid in the x ray, were of greatest value. The clinical picture of these streptococcus infections will be discussed at greater length later on.

The pneumonic process seen during this period has been classed by Lucke in his report as Type II. It is similar to that already mentioned except that the lesions are not distinctly peribronchial, they are more confluent and hemorrhagic, and the accompanying bronchitis is much more intense, the mucosa being so turgid in places that the lumen is closed.

*Fourth Period. Second Measles Measles Pneumonia, and Streptococcus Period
March, April and May, 1918*

Total number of measles	414
Cases of measles pneumonia	54
Mortality	17
Percentage of mortality	31 (first epidemic 19.4 per cent.)
Empyema following measles pneumonia	15
Mortality	2
Percentage of mortality	13

This second measles, measles pneumonia, and streptococcus epidemic, as will be noted above, was distinctly more severe than the first epidemic. Patients came into the hospital even more acutely ill and prostrated than in the first group and died in considerably higher numbers. This may be seen in the heights of the curves on the charts, as well as the increase in mortality, from 19.4 per cent. in the first epidemic to 31 per cent. in the second. These boys died in spite of treatment, nothing that could be done making the slightest impression on their condition.

Further, compared with the first epidemic, twice the num-

ber developed empyema (3.6 against 1.8 per cent), although the empyema mortality was lower (13.3 per cent in the second, 33.3 per cent in the first). This may be interpreted as due to improved methods of empyema treatment, as well as the fact that in these severe infections the development of pleuritis is probably a beneficent process, and indicative of good defensive reactions of the body in combating the disease, similar to the development of fever, leukocytosis, etc., in various other infections. This conception finds confirmation in the improved results from delayed surgical interference, analogous to the improved results in cases where hyperpyrexia is not too actively combated, and leukocytosis is encouraged.

In this series hemolytic streptococci played a much greater rôle than in the first measles epidemic, the general clinical and pathologic picture really being that of a generalized streptococcal sepsis with hemolytic streptococcus demonstrable in bloodstream, in secondary abscess, and at autopsy, in pericardial and peritoneal fluids. Pathologically, the lungs showed bronchopneumonia or pseudolobar pneumonia.

Fifth Period Decline of Epidemics May, June, and July, 1918

Total number of measles	396
Total number of measles pneumonia	9
Mortality	1
Percentage of mortality	11.11
Total number cases of pneumonia	114
Mortality	8
Percentage of mortality	7.9
Total number of empyemas	26
Mortality	4
Percentage of mortality	15.4

This fifth period is interesting, showing the marked improvement in morbidity and mortality conditions with the advent of warmer weather, although it is evident that at no time was the camp entirely free from infection. In attempting to analyze the reason or reasons for this improvement in the disease rate, there are various factors to be considered, which in the order of their importance may be listed as follows:

(A) With advent of warmer weather the men live a much greater part of the time out of doors and are not crowded in overheated and, for the most part, poorly ventilated rooms

(B) Because of the milder weather the lowering of vitality due to chilling—exposure to wet and cold, snow, rain, and ice—is absent

(C) As a result of being out doors more, better opportunities for drill and exercise are afforded, so that the men's own resistance is heightened, and their ability to withstand infection increased

(D) A decrease in virulence of the infectious agents A study in streptococcus carriers, to be referred to later, gives unmistakable evidence of the decrease in virulence of the organisms themselves This is evident not only from a marked lowering in the relative percentage of streptococcus carriers in the camp and in the hospital but also in a marked decrease in complications and severity in disease resulting from these organisms

B Discussion of the Incidence of the Cases as Shown by Plates and Curves—The last section (A) has traced the clinical diagnoses in their varying occurrence, while a study of the plated curves shows other and somewhat significant facts

It is to be mentioned at the outset that the appended diagnoses are based upon the data available from our records made during the stress of work incident to the epidemic and under difficulties We have attempted to exclude artefacts such as might occur in tabulating bacteriologic findings, but doubtless some have crept in Data concerning case incidence, diagnoses, and complications are easier to get than bacteriologic records, and for the very early part of the season here covered, laboratory work was not as extensive as later on With this understanding we offer the following observation upon the curves

The curves charted by weeks indicate total cases, the outlined blocks, the total of determined cases, the blackened blocks, the deaths

Chart II shows, in addition to the references made elsewhere, the relative importance of the pneumococcus in the early

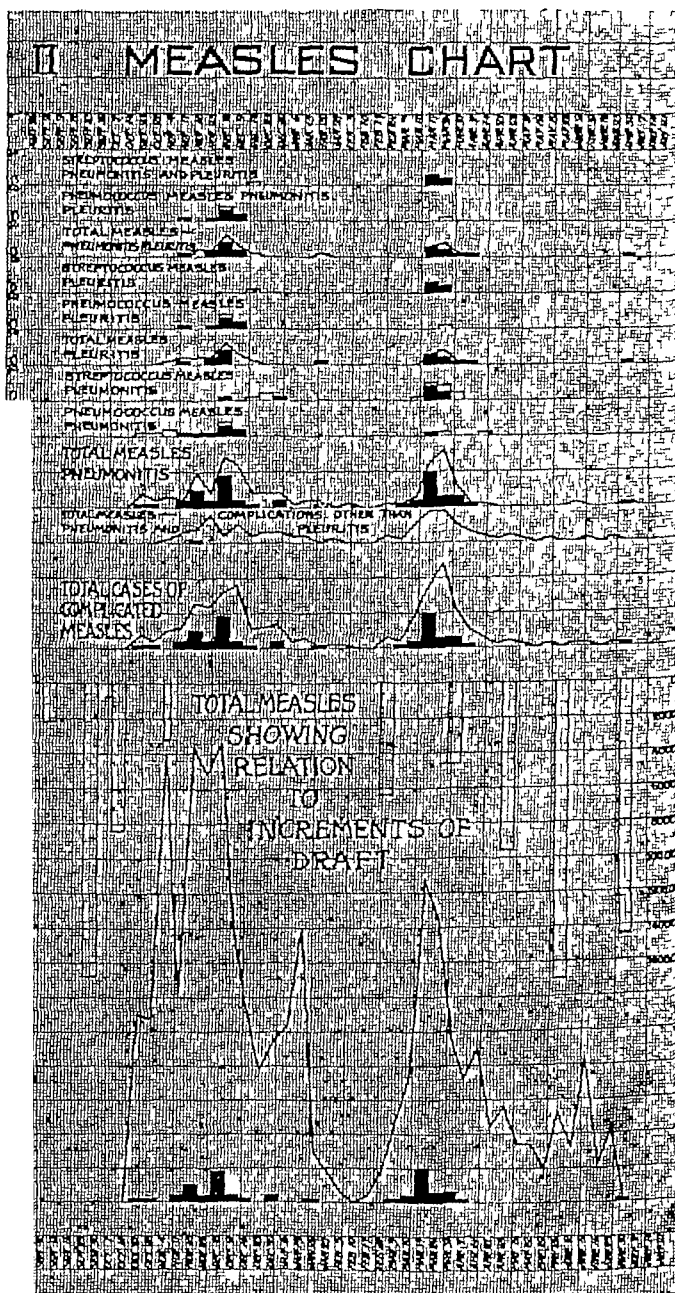


Fig 59 —Chart II

rise of measles and the evidence of streptococcus complications in the spring outbreak. This is again shown in Chart III, where all non measles pneumonia and total empyemas are plated

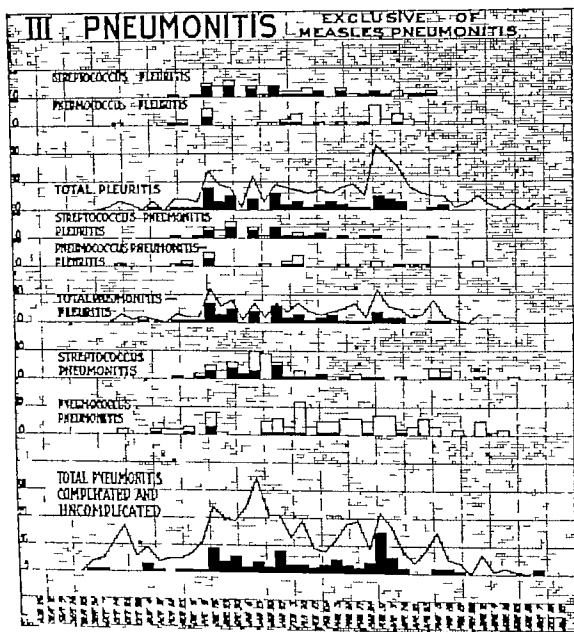


Fig 60—Chart III

It seemed well to indicate other manifestations of streptococci and pneumococci, and they are portrayed on Charts IV and V

Chart VI is merely intended to show the greater incidence of respiratory tract disease in the spring made up chiefly of infec-

tions of the larger bronchial passages and of the acute febrile diseases without special localizations in the upper respiratory organs (grip)

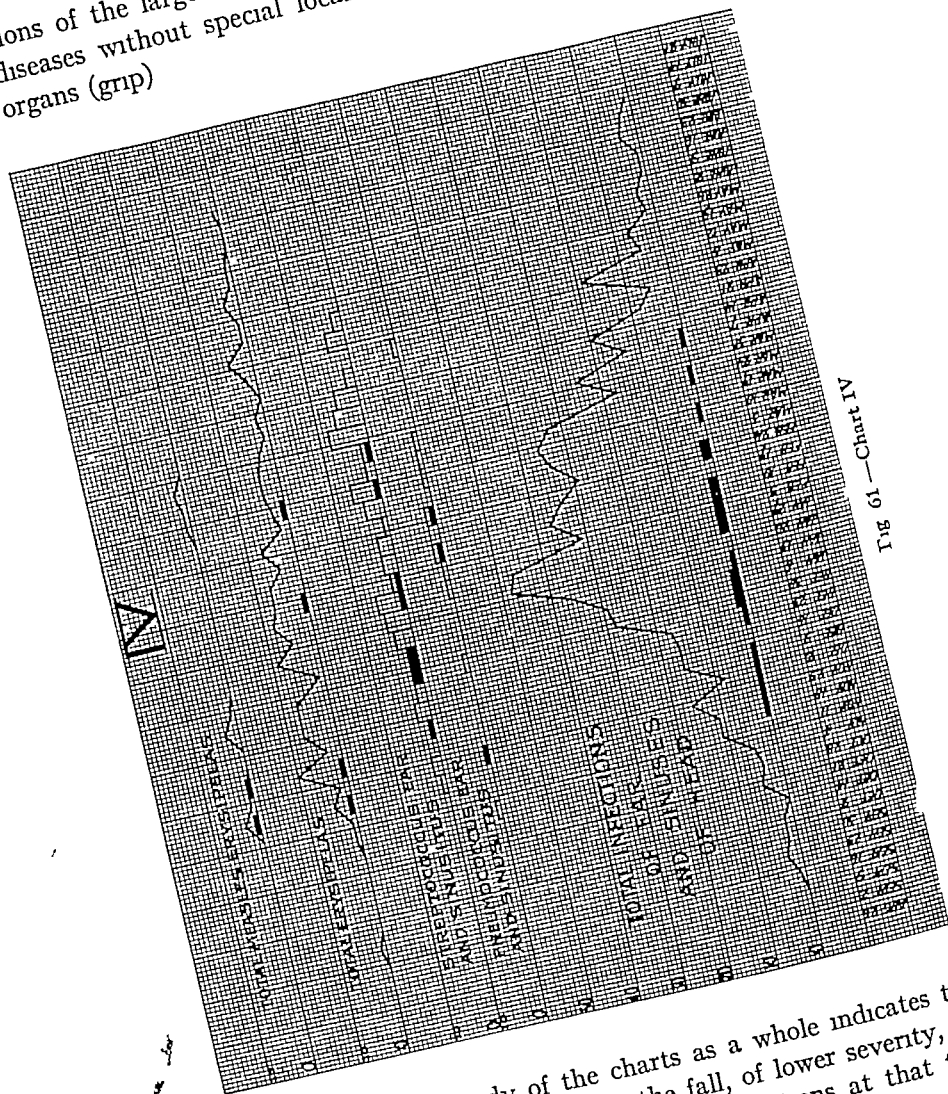


Fig 61—Chart IV

In general, a study of the charts as a whole indicates that measles cases were numerous in the fall, of lower severity, and often complicated with pneumococcus infections at that time, while later the streptococcus became the important organism

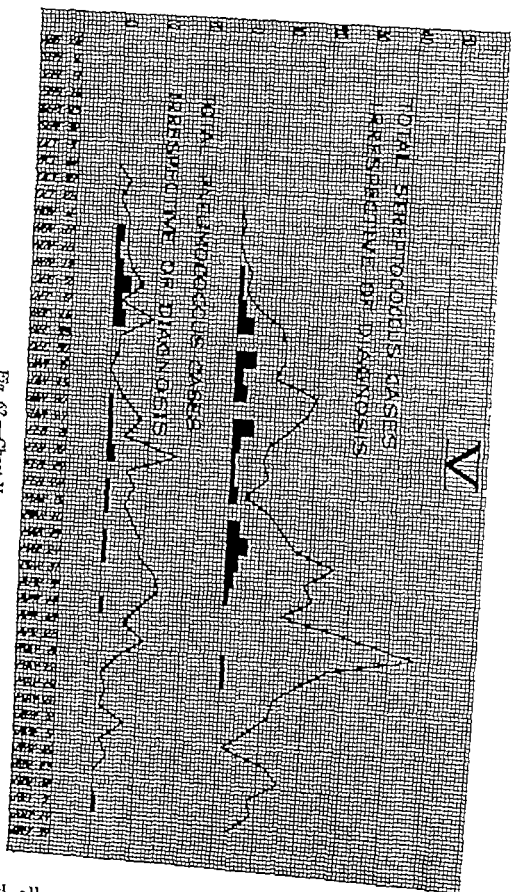
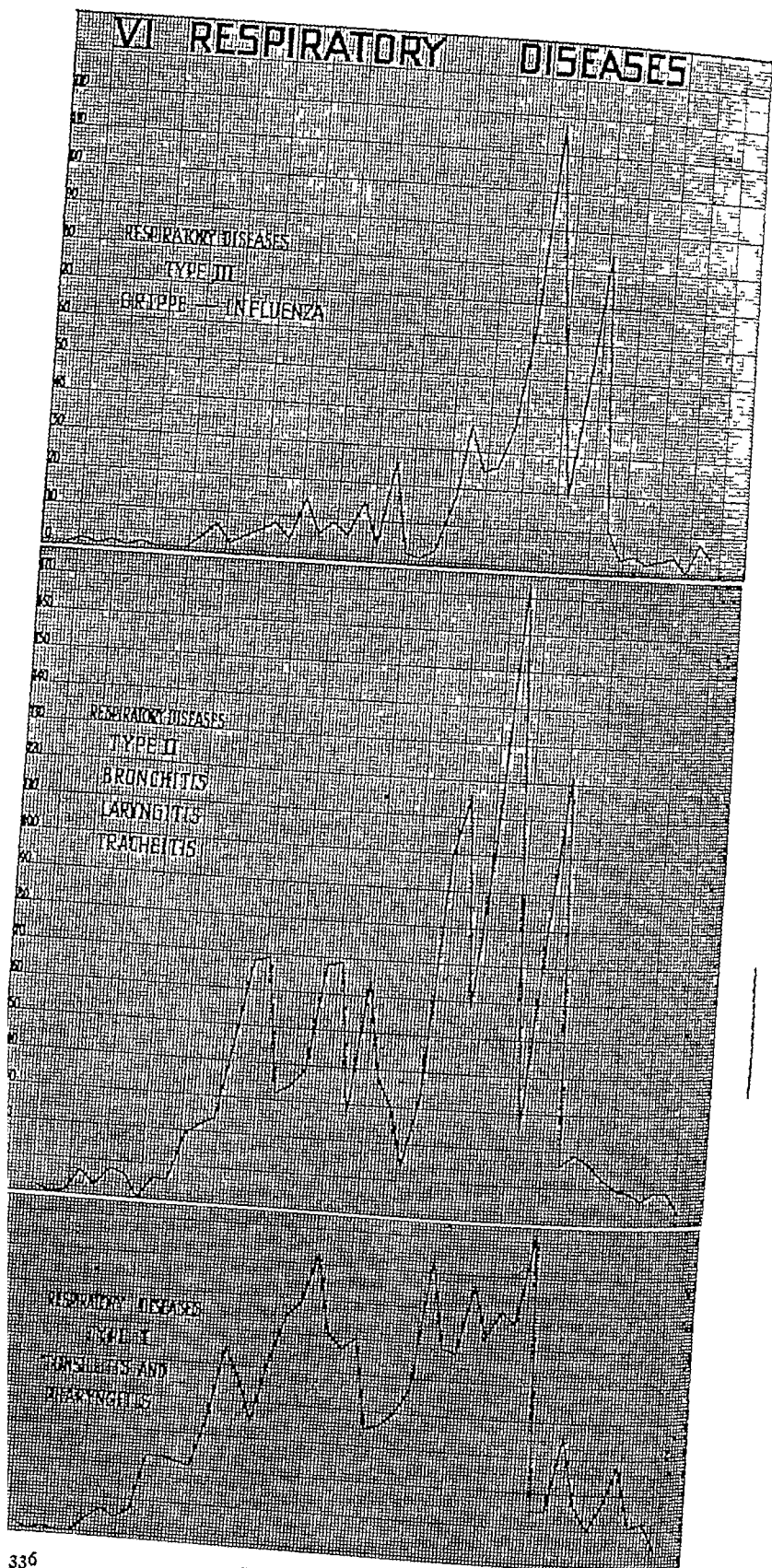
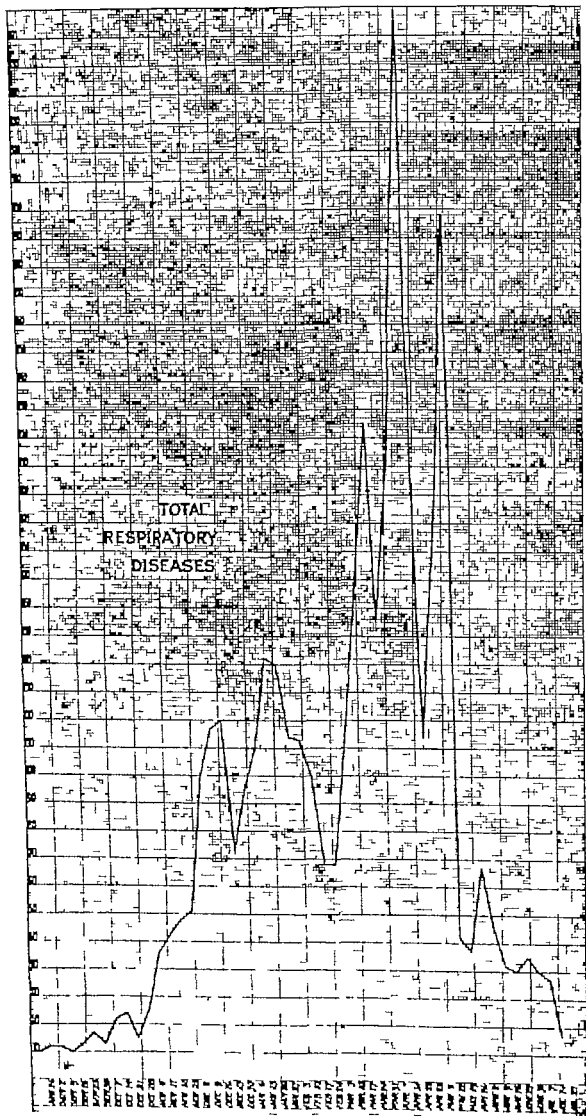


Fig. 62—Chart V

Indeed, all mortalities with pneumococcus are higher in the fall and those from streptococcus higher in the spring. While there





is a rough parallelism between the high points of totals and the mortality, it is noteworthy that in the measles at least the highest number of deaths is just before the highest number of cases

Pneumococcus cases, while fairly uniform through the period covered, tended to become less fatal Streptococcus cases progressed upward in an irregular course with a fairly uniform mortality until April, when deaths declined, but cases increased

The curve of measles and streptococcus infections are roughly parallel until this great rise, at a time when measles was falling rapidly This is indicated in another place in the mortality from collected pneumonia (Chart III) during March and April

We believe that the uniformity in the charts of measles and streptococcic infections rather indicates that they are not in separable, for if the streptococcus were dependent upon measles, the virulence, that is, case incidence and mortality, should show a more sustained rise during the winter instead of falling very low in February

In order that the position of other variables might be evaluated Chart IV was prepared The important things—pneumonia, measles, pleuritis—have somewhat overshadowed other signs of infections in the camp For example, infections of the ear and sinuses of the head are found to rise very steadily and were well established before any of the above were under way Erysipelas, known in 2 cases to be due to the Streptococcus hemolyticus, had started before measles or pneumonia, and was present in 18 cases late in the winter, only 5 of which were in measles The point is of some practical value as well as of academic interest to get an idea of the relationship of measles and streptococci We feel that the streptococcus was with us very early in the autumn, and one of us examining smears from sore throats and cultures on Löffler's serum for diphtheria in September was struck with the frequency of finding enormous numbers of long chain streptococci

III. BACTERIOLOGY

Pneumococcus—Pneumonia type determinations were made in the laboratory either by the mouse or the new Avery method. In general, the results obtained by the two methods agreed fairly well, although the mouse method is much preferable. Up to July 1, 1918, 198 type determinations of sputum of pneumonia patients were made, divided as follows

Type I	Number of cases	40
Mortality		7
Percentage of mortality		17.5
Type II.	Number of cases	49
Mortality		4
Percentage of mortality		81
Type III.	Number of cases	4
Mortality		1
Percentage of mortality		25
Type IV	Number of cases	105
Mortality		14
Percentage of mortality		13.5

These type determinations, grouped according to months, were as follows

	1917			1918						Total
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June.	
Type I	1	3	0	4	11	14	6	1	0	40
Type II	0	3	0	3	7	6	14	7	9	49
Type III	0	0	0	0	0	0	0	4	0	4
Type IV	1	10	1	7	10	23	41	9	3	105

Bacteriology of empyemas up to July 1st included the examination of 199 cases, divided as follows

Hemolytic streptococci.	Number of cases	127
Mortality		43
Percentage of mortality		33.8
Pneumococcus (type undetermined) cases		31
Mortality		14
Percentage of mortality		45.1
Undetermined.	Number of cases	41
Mortality		12
Percentage of mortality		25.2

Since July 1st special studies have been made on the pneumonias and empyemas regarding the type pneumococcus from several examinations of the sputum, blood, pleural fluid, and from lung tissue and heart's blood at autopsy. These studies were made, as frequently in the past, two or more different types of organisms had been found in a single case. We have collected 59 cases of such multiple findings. These 59 cases, for purposes of discussion, may be divided into three groups.

Group I 11 cases in which pneumococcus, Type IV, and one other type has been found, either Type I, II, or III. It is probable that in such cases the Type IV organism should be considered as a contamination from the saliva and mouth secretions, as it has been shown that this rather ill-defined group of pneumococci are normal inhabitants of the mouth flora. In these cases a second or third examination should be made, with particular care that a true lung specimen, washed free from saliva, is obtained. If on such repeated examinations Type I, II, or III are found, they should be considered the etiologic organisms. Now typing is done every third day, except when IV is found, when it is repeated on three successive days for confirmation.

Group II 3 cases in which combinations of Type I, II, or III were found. Such cases are of extreme interest, as they are the so-called fixed types of pneumococci. So far as we are aware such cases have not appeared in the literature, and we shall therefore quote them very briefly as follows. Case I E B Lobar pneumonia, Type III (July 26, 1918) and Type II (July 30, 1918) found in his sputum on two different examinations. Case II O D Lobar pneumonia (June 28, 1918) with empyema (July 7, 1918). Type II in the sputum (June 28, 1918) and Type I in the pleural fluid (July 17, 1918). Case III C W Lobular pneumonia, Type I (July 23, 1918) and II-A (July 24, 1918) found in the sputum on two different examinations.

Group III 32 cases in which both pneumococcus and streptococcus were found. These are to be considered cases of double infection with a primary pneumococcus in sputum or

blood-culture, and a secondary streptococcus in pleural fluid or other exudates, such as pericardium, peritoneum, mastoid, septic joints, etc. Occasionally streptococcus was found primarily in sputum, with pneumococcus late in the pleural fluid. Six cases of empyema showed a primary streptococcus with secondary pneumococcus. In these cases pneumococcus was found in the second and third pleural tapplings at the time when the pleural exudate became thick and purulent.

Special virulence tests of these organisms have been made, but not yet reported, but from clinical experience and from the percentage of carriers of cases coming into the hospital at the height of the epidemic it appears that variations in the virulence of organisms must have occurred. The increase in mortality of the second measles-pneumonia epidemic in March, referred to above, may thus be due to an increase in virulence of the streptococcus, from repeated passage through newly arrived troops. Similarly the decrease in disease rate and severity which occurred with the onset of warmer weather would appear to be associated with a corresponding decrease in virulence.

Streptococcus.—With few exceptions all organisms isolated were of the hemolytic variety. In pleural fluid, in active cases, large numbers of short and long chains of streptococcus were present in smears. Biologic tests carried on by Lieutenant Lucke, to be published, have shown that streptococci isolated from various sources are alike in their biologic characteristics.

IV HYGIENE

1 *In Camp—Depot Brigade*.—The Depot Brigade is the receiving area of the camp, in which all freshly received recruits are quartered during their first months in military service. It is during this first month or six weeks of camp life that the large percentage of these severe infections occur. The factors responsible for this high disease incidence at such times may be said to be due to a lowering of vital resistance and ability to fight infections resulting from wide deviation in practically every particular from the usual mode of life. These changes,

spring, 15 per cent. of the new draft men harbored hemolytic streptococci in their throats, while within three months 83 per cent. carried them. In this respect the Depot Brigade may be considered an incubator for the cultivation of these organisms

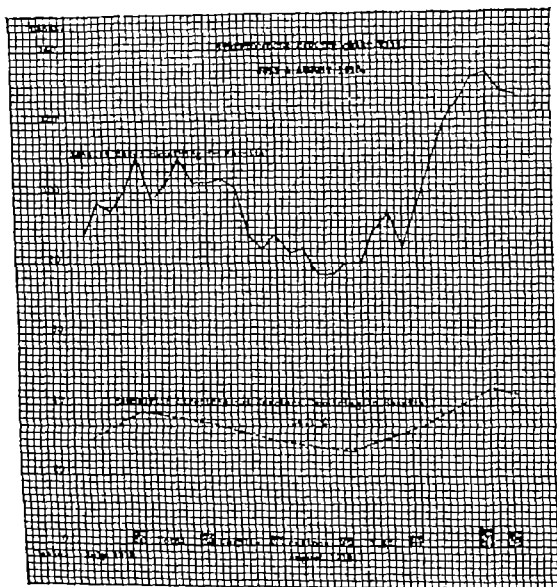


Fig 66—Chart VIII Streptococcus carrier Note the low percentage (34.1) of streptococcus carriers, with a corresponding low percentage (3.5) of complications. (Contrast with Chart VII)

Regimental Infirmaries—These being the points to which men report on sick call, are, in times of epidemics, because of crowding of large numbers in small stuffy rooms, areas where the spread of infectious disease occurs. Such spread results from the close crowding of 50 to 100 or more men in

a small, poorly ventilated room, breathing and coughing into each others faces, swapping cigarettes and tobacco with sputum smeared hands, and general dissemination of nasal and oral discharges

Barracks—Squad rooms and mess halls in barracks are fertile sources of infection, either from direct contact or from the dust sweepings, or food, water, and milk-supply in such places. Many streptococci were found in the dust of those barracks where the percentage of infections ran highest. When dry sweeping was supplanted by soap and water and disinfectant solution scrubbing, disease incidence was sharply cut down.

2 *In Hospital*—The Receiving Ward of the hospital stands in the same relation to the General Wards as the Depot Brigade does to the general camp organizations, and unless special measures of cubicing and masking are used, the spread of infection undoubtedly occurs. Various measures for preventing such dissemination were introduced into the hospital at the height of the epidemic, together with separate entrances for contagious and non-contagious diseases, and, without doubt, these measures have been of material assistance in cutting down the spread of disease from such source.

General Medical and Surgical Wards—It was early recognized that cross infections would probably occur in the general medical and surgical wards. However, with the introduction of modern methods of isolation, use of cubicles, gowns, and masks, and later by the segregation of measles and respiratory cases into streptococcus carrier and non-carrier wards, the incidence of cross infections was markedly reduced.

Hospital Personnel—The personnel of the Base Hospital consists of officers, nurses, and enlisted men. It was observed that while the disease incidence of the hospital was quite high, the mortality was extremely low, there being only one death in an officer (pneumococcus-meningitis), no deaths in the nurses, and only three deaths in the enlisted men. The rate of disease was much higher in the enlisted men than in the nurses and officers, and, in general, these men, like the troops

generally in this camp, were drawn from rural sections more than from urban communities. It is interesting to note further that organizations such as the Medical Corps, Quartermaster Corps, Cooks and Bakers School, and similar organizations, not exposed to severe outdoor drill and exercise, with exposure to cold and wet, suffered much less from respiratory diseases than the regular line organizations. These observations hint at some of the sources of the diseases under discussion.

V CLINICAL PICTURE

In the paragraphs above the striking features of the clinical picture have been described. However, there are a few points which it might be profitable to discuss further.

Pneumonitis.—All varieties represented.

Typical lobar, with rusty sputum, with crisis on the seventh to eleventh day. There were either small localized patches of consolidation or a large massive pneumonia involving all lobes of both lungs.

Typical broncho- or lobular pneumonia, with scattered areas of consolidation. At times there was considerable difficulty in differentiating between severe acute bronchitis and multiple small areas of bronchopneumonia.

Atypical lobar pneumonia, without chill or rusty sputum, with long prodromes of cough and general lassitude, without frank signs of consolidation. In many cases the pneumonic consolidation was an incident, the disease being a true pneumococcus or streptococcus sepsis with secondary pleuritis, pericarditis or polyserositis, with many complications—otitis media, mastoid, erysipelas, septic arthritis, cellulitis, meningitis, nephritis, etc.

Onset.—At times this was prolonged, following a week or two of "cold," "cough," "sore throat," general lassitude and slight fever, at times acute, following definite history of exposure, fatigue, wetting, chilling, etc., from lying in snow on rifle range, passing the night in cold wet practice trenches, after guard duty in the ram when the slickers had become drenched through, after long hikes through snow and mud with soaked

shoes and stockings. Sometimes the condition developed insidiously without apparent chill or pain, the soldier insisting he was not ill. More often it was fulminant, distressing, with unbearable pleural pain, panting respiration, sometimes with profound weakness, almost to collapse and coma.

Course—This was sometimes short, with prompt crisis within a day or two of admission, with miraculous change from apparent critical illness to comparative ease and comfort. Sometimes the course was short, but with increasing severity, with rising temperature, pulse and respiration, deepening cyanosis, rapid grunting breathing, tympanites, restlessness, finally with thready pulse and deepening coma, until death. Often complications developed, a to-and-fro friction over the heart from beginning pericarditis, increasing abdominal distention and tenderness from peritonitis, deepening blush about nose, cheeks, ear, and mouth from erysipelas, severe joint and limb pains from septic arthritis and cellulitis, ear and bone tenderness, with enlarged tender cervical glands from otitis media and mastoid disease.

Convalescence—Recovery was often prolonged and tedious, convalescence being accompanied by much loss of weight, cachexia, and inanition. Frequently, rapid irregular heart, difficulty in standing and walking, tremors, fibrillations, vasomotor clamminess of palms and soles, dyspnea on slight exertion were present for a long time. Intercurrent infections, slight temperature rise, cough, red throat, occasionally severe late sequelæ, erysipelas, joint abscess, cellulitis of face and scalp, septic mastoiditis with thrombosis of lateral sinuses or brain abscess, not infrequently multiple exanthemata complications, mumps, chicken-pox, German measles, these complications were very common during this period. The discharge slip of many patients appeared much like a glossary of the communicable diseases.

Pleuritis.—This was radically different from the usual well-known types of para- or metapneumonic empyema. In many cases the pleuritic process occurred very early, the disease being ushered in often insidiously without symptoms, often severely acute, with urgent pleural pain, cyanosis, grunting dyspnea,

marked prostration, and overwhelming toxemia, often primary without pneumonitis, often the only prominent symptom of a general sepsis. The early, clear, serous fluid (containing streptococci) later turned into a thick creamy exudate, with a corresponding improvement in the clinical condition of the patient. The treatment of the acute severe empyemas was the most difficult problem of the year's experience to solve. However, the basic problem is neither the medical nor surgical treatment of empyema, but the general streptococcus problem, viewed from the epidemiologic and prophylactic standpoints. In this sense the problem comprehends, as Colonel Welch has put it, "the starting points and agencies concerned in spreading these streptococcus infections in camp, hospital, and civil communities, the carrier problem, the rôle of pre-existing infections, etc."

In general, the clinical picture may be said to be that of pneumonitis, described above, with a few exceptions, particularly the local chest signs and symptoms. In these patients the onset was often even more acute, the course more severe. There were noted intense chest pain, with inspiratory exacerbations, often constant and deep-seated, asymmetry of the afflicted side, with unilateral fulness and diminished excursion. Sometimes, however, the pleura was quite packed with pus, but without subjective complaints.

The difficulty of physical examination has been mentioned. Localized or extended dulness, approaching flatness, was always suspicious and usually confirmed by needling or x-ray. However, small anterior pockets, or pockets between mediastinum and lung, or between lobes, was always difficult to diagnose, and even more difficult to reach.

Measles—All varieties were represented, from the mildest to the most severe.

Of particular interest were the cases coming in acutely and severely ill with marked respiratory symptoms, cough, cyanosis, amounting at times to blue-blackness of the face and ears, often with complicating pneumonia and empyema. In the second epidemic death from pneumonia or streptococcus

sepsis occurred often before empyema had time to develop. These cases of measles with associated streptococcus sepsis with such very high mortality are among the most severe types of disease we have ever seen, being only comparable to the most profound cases of general sepsis and profound toxemia.

Streptococcus was present in all of the above, and in all probability was the predominating factor in them and was responsible for the majority of the severe symptoms. Hemolytic streptococci were isolated from the typical pneumonias and empyemas, middle-ear and mastoid diseases, erysipelas, and many other complications which have been mentioned.

It should be stated that in our opinion the clinical picture of pneumonitis and pleuritis has so overshadowed the clinical picture of other streptococcus infections that the latter have very nearly been lost sight of. In this connection we would emphasize the importance of severe streptococcus sore throat with purplish redness, edema and prominent lymph-follicles, streptococcus laryngitis and trachitis, with hoarseness and hacking, prolonged cough, acute middle-ear and accessory head sinus diseases, sudden acute "grips" with prostrating headache, backache, joint and limb pains, red throat, etc. Accompanying the above there were slight temperature rise and feeling of lassitude and tire, and later the characteristic and protracted convalescence accompanied by loss of weight, pallor, and "gray feel and look," cough, repeated colds, and weakness. Fully 75 per cent of the hospital personnel fell victim to the above "benign" type of streptococcus diseases, at one time or another, during the epidemic.

VI. METHODS ADOPTED TO CONTROL THE EPIDEMICS

CAMP

It became evident early in the course of the epidemics that the problem of their control was not confined to the hospital, but was a problem of the entire camp, even the extra cantonment zones, and its solution demanded the close co-operation of all medical organizations concerned. The necessity of wide-reaching sanitation and prophylactic measures became the more

urgent because of the very high mortality in the new men coming into the hospital, and the fact that many of them, in spite of all treatment, succumbed in a few days to these severe and virulent infections

Believing that the control of this situation demanded the most far reaching measures, our attention was first turned to the new recruits at the time of entrance into the Depot Brigade. For the improvement of this situation and for the control of some of the factors spoken of above (Paragraph IV) it was recommended that a Detention Camp be started. The following abstract of report, submitted to the Surgeon General, is indicative of the situation at that time

"3 Detention Camp—The portal of entry of men and infection to the camp is, in most cases, the Depot Brigade, and it is here, owing to close intermingling of fresh recruits, assignment by the personnel office of small groups of new men to all companies, too rigorous and prolonged drill schedules, lack of knowledge of personal hygiene and methods of spread of communicable diseases, that the soil is prepared for future infection, and wide-spread dissemination results. It would seem that the Depot Brigade bears the same relation to the general camp as the receiving ward of a hospital to the general wards, and methods of observation and segregation are imperative in both instances

"*Recommendation*—It appears highly desirable that a specially constructed incoming detention camp be established in each cantonment for the purpose of segregation and observation of drafted men. This camp should be composed of small units of from 20 to 30 men, who shall mess, sleep and drill together, so that internal quarantine of such small units may be established if necessary. This incoming detention shall be maintained rigidly for three weeks, during which period recruits shall be given their typhoid and small-pox vaccinations, watched carefully in small isolated units for early recognition and separation of contagious diseases, given very gradually increased exercises and drill formations, instructed daily in a practical way in personal hygiene and in methods of spread and prevention of communicable disease. The detention camp shall be surrounded with a high wire fence to assist in preventing social intercourse with the remainder of the camp as well

as with the outside civilian population, and shall contain sufficient regimental infirmaries. In addition, a special building shall be constructed to house a bureau with adequate personnel and laboratory equipment, for the purpose of making clinical and statistical studies of the new men. These studies might include such things as detention and isolation of streptococcus carriers, studies in prophylactic streptococcus vaccination, weight studies, etc. A special officer shall be assigned as bureau supervisor to inaugurate and correlate this work.

"An out-going detention camp shall likewise be established to house the same number of men as the incoming camp. Men being transferred to other camps or to points of embarkation shall be detained here for three weeks. During such time observations and records similar to those made in the incoming camp shall be made. The men's service records and other paper work incident to their departure might also be completed at this time."

After new troops had been in the Depot Brigade for a period of from one to three months they were transferred to the more permanent organizations of the division or the camp, and at times of epidemics report to the Regimental Infirmaries for sick call. In order that the highest degree of efficiency of the Regimental Infirmaries could be obtained, and after considerable study and observation of their methods of work, the following recommendations for the work of Regimental Infirmaries were made:

"4 **Regimental Infirmaries** —To a very high degree the success or non-success of the medical services at base hospitals depends upon the work of the regimental infirmaries and regimental surgeons. These places may be considered as the out-patient departments of the base hospital, and should be subjected to the same careful organization and inspection as the latter.

"*Recommendation* —Standardization and uniformity in the work of regimental infirmaries shall be developed. This should include uniformity in the taking of sick call, daily inspection of the entire command, uniformity in the minimum requirements of the examinations, viz, examination of one soldier at a time in a closed room, taking and

recording of temperatures, each soldier stripped to the waist, his throat inspected with the aid of a tongue depressor, masking of soldiers while waiting for examination to prevent the spread of respiratory disease in the infirmary, establishment of a small observation ward of from 6 to 12 beds, establishment of a small laboratory in connection with the ward for clinical work. At the weekly conference with the regimental surgeons, the Division Surgeon, the Division Sanitary Inspector, and all regimental surgeons except the officer of the day shall be expected to attend. At times of new increments of drafted men there shall be arranged either an additional staff for this work, or the examination shall be put at a time not to conflict with the daily sick call and daily inspection."

During their daily routine and particularly when indoors, between the hours spent in sleep in the squad rooms and at mess, the spread of communicable disease occurs probably to a greater extent than when at drill, hike, and play outdoors. To control this situation as far as possible the following recommendations were made:

"6 Communicable Diseases—*Recommendation*—The masking method inaugurated at Camp Grant for the control of communicable diseases at the Base Hospital shall be extended into the work of the regimental infirmaries, particularly at the time of taking sick call, where hundreds of men congregate in small stuffy corridors waiting for examination. A sick soldier listed for transfer to the hospital shall replace his mask after the examination and wear it constantly until he reaches his bed in the cubicled ward (Figs 67 and 68). Throughout the detention camp and in quarantined barracks in general a cubicle system for the men's cots or a simplification of same shall be adopted (Figs 69-71). The cubicle method should be extended in these localities to the mess by stretching small sheets, 30 inches in width, down the center of the mess table, 6 inches from the top (Fig 72). This will prevent to some degree infection being spread across the narrow table. The men shall be assigned in their own groups to permanent places in the mess room. This method of table cubicling and permanent mess assignment shall likewise be installed in the central mess of the base hospital" (Figs 73 and 74).



Fig 67 —Arrival of ambulance at receiving ward, showing masking of patients.

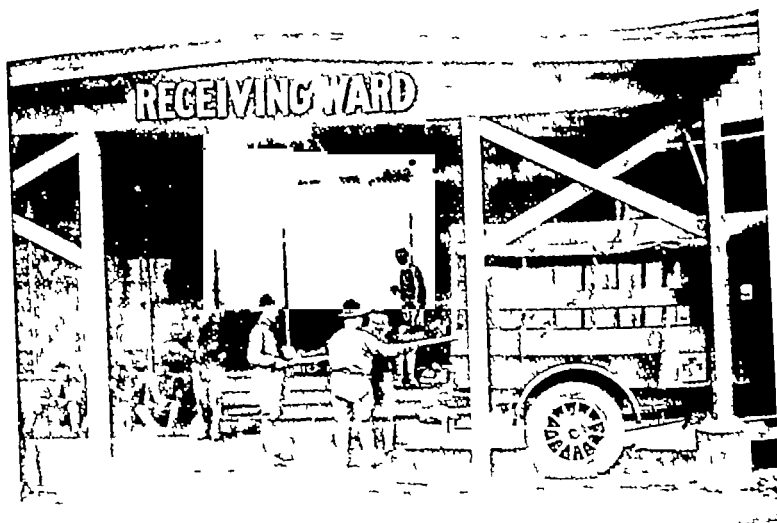


Fig 68 —Removal of litter patient (masked) from ambulance



Fig 69—Squad room in barracks of 159th Depot Brigade, showing bed cubicles in place.



Fig 70—Soldiers asleep on adjacent beds, protected by cubicles and alternation of head and feet.



Fig 71 —Soldier asleep in cubicled bed

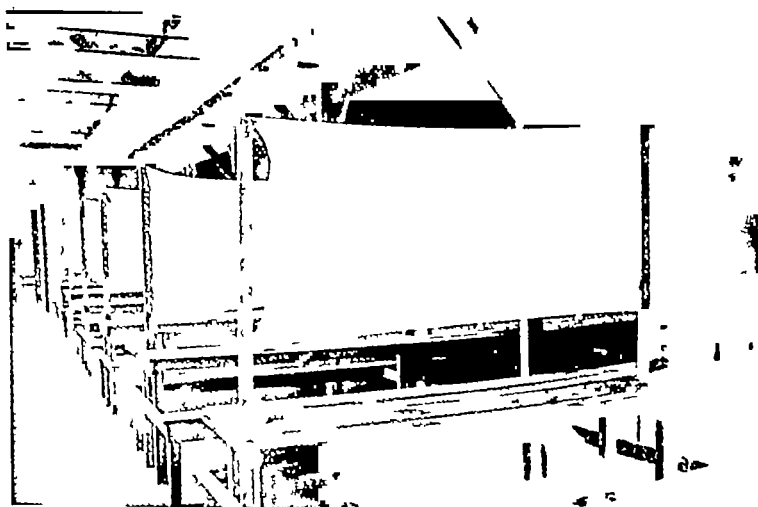


Fig 72 —Mess room in barracks of 159th Depot Brigade, with cubicles suspended down center of mess table Note bottom of sheeting is too far above top of tables, and should not be over 6 inches

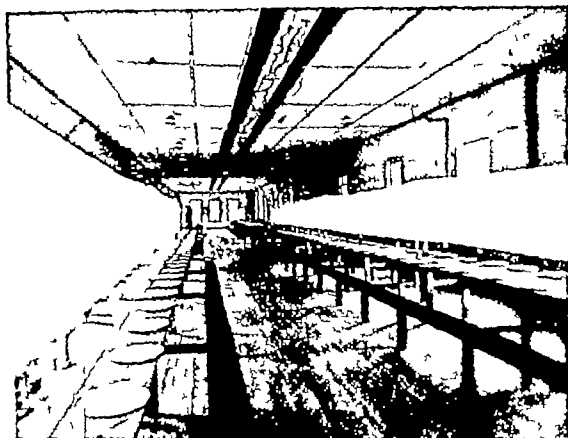


Fig. 73.—Central mess, Base Hospital with cubicled mess tables.

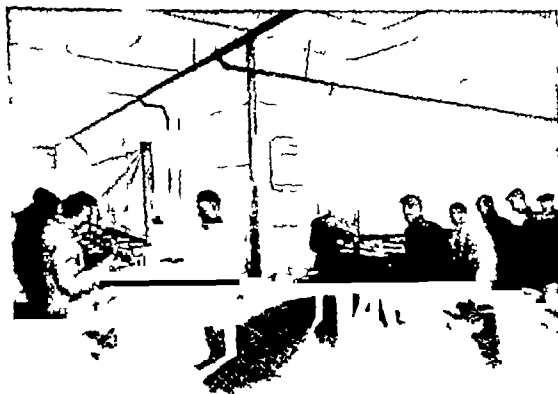


Fig. 74 —Patients at central mess, Base Hospital.

In order that the entire camp contagious disease situation could be studied and analyzed and because of the urgency of the situation in general a Board of Officers was appointed by the Commanding General, April 5th, in accordance with the following order

“Headquarters Camp Zachary Taylor,
Louisville, Kentucky,
April 5, 1918

Special Orders
No 95

Extract

2 The verbal orders of the Commanding General of April 1, 1918, designating

Lt -Col Luther R Poust, M C ,
Major W W Hamburger, M R C ,
Major John H Telfair, M R C ,
Capt David M Roberg, M R C ,

as Board of Officers to investigate, report upon, and submit recommendations with a view to preventing the importation and spread of contagious diseases in this camp through the 159th Depot Brigade, are hereby confirmed and made of record

By command of Major General Hale

W H Bell,
Major, Infantry, N A ,
Camp Adjutant ”

As a result of the deliberation of this Board the following recommendations were made

“Office of Camp Surgeon
Camp Zachary Taylor, Ky ,
April 4, 1918

Proceedings of a board of Medical Officers convened by verbal order of Camp Commander herewith enclosed

Per verbal order of the Camp Commander a board composed of the following officers will meet at the earliest possible time

to investigate and recommend referable to insanitary conditions in the recent draft

Lt. Col L R Poust, M C, N A.,
Major Walter Hamburger, M R C,
Major John H Telfair, M R C,
Capt. David M Roberg, M R C "

"The Board met Tuesday, April 2d, at 3 00 P M present, all members. Adjourned at 5 00 P M. Board convened at 9 00 A M., Wednesday, April 3d, and adjourned at 12 00 noon. Board convened at 9 30 A M., Thursday, April 4th, and adjourned ~~me die~~ at 12 noon.

The following recommendations are made

1 That sheeting 36 inches high be suspended over median lines of mess tables. The bottom of sheeting to be 6 inches above top of table Detachable (see Fig 72)

2. That sheeting 2 feet high be installed on one side of each bed, uprights to be attached to head and foot of bed, connected by wire from which sheeting will be suspended. Bottom of sheeting to be tied to bed rod. Detachable (see Figs 69-71)

3 Men in each company to be separated into five groups according to squad room occupied, each group will remain by themselves absolutely except during outside formations. To this end certain mess tables will be allotted or assigned permanently to each group Three men or less are to be seated to a section on one side of a mess table.

4 Battalion Surgeons will instruct the men while eating in the purpose of the cubicle system Instructions to continue for one week.

5 That a guard be placed in each company lavatory to prevent unnecessary loitering

6 Y M C A buildings, K of C, and Post Exchanges in Depot Brigade to be closed after retreat. To remain open during the day to members of unquarantined organizations Inside entertainment to be replaced by outside or open air entertainment for the benefit of unquarantined organizations, quarantined organizations to remain in quarantine.

7 That no person or persons be allowed to leave main road

passing through Depot Brigade except authorized persons delivering or receiving parcels This to be enforced by guards

8 That 1st Prov Training Regiment be quarantined together with 515th Engineer Service Battalion and that this entire area be made a detention camp No one to be allowed to enter or leave this area except authorized persons delivering or receiving parcels

9 That the period of detention be increased from two to three weeks from the time of entrance of last quota

10 That old draft of 2500 men be transferred from the 159th Depot Brigade to two organizations of the Division (as the 335th and 336th Infantries), these men to be rigidly quarantined apart from permanent personnel for a period of two weeks

11 The above measures are to be considered merely as emergency steps to meet present existing conditions until such time as an adequate detention camp accommodation can be secured The present unsatisfactory condition is due, among other things, to the assignment of incoming draft to various organizations in the Depot Brigade, thus distributing most widely communicable diseases

It is the opinion of this Board that the whole problem of a permanent detention camp be carefully considered The Board strongly advises that a permanent detention camp be provided

(Signed) L R Poust,
Lt-Col M C, N A,
President "

In addition to the above it was found desirable to recommend rigid attention to sweeping and cleaning with disinfectant solutions, because streptococcus had been found repeatedly in dust of barracks, especially in the case of one Field Hospital, where 90 per cent of personnel had acute infections

METHODS ADOPTED IN HOSPITAL

Receiving Ward—Use of Masks and Cubicles Throughout Hospital.—The Receiving Ward was arranged with cubicles for

the reception and segregation of patients (Fig 75) Preliminary paper work was taken down directly on typewriters, both patients and clerk being masked continuously (Fig 76) After examination by the receiving officer patient is assigned to proper ward, continuing to wear mask until placed in bed between cubicles (Fig 77) On communicable disease wards officers, nurses, and orderlies are masked and gowned at all times and patients when up and going about ward or to latrine



Fig 75—Interior of receiving ward, showing arrangements of cubicles.

wear masks Convalescent patients take their meals for most part on their own wards, but occasionally, because of crowding, etc, go to the central mess, and here are assigned to separate permanent table places, each ward by itself, with sheets stretched down center of mess table (see Figs 73 and 74)

Medical Treatment—Within the limits of this report it would not be profitable to discuss at length all the details of the treatment of these cases We shall therefore confine it to the following points



Fig 76—New patients (masked) waiting in receiving ward cubicles,
Sergeant (masked) types admission cards.

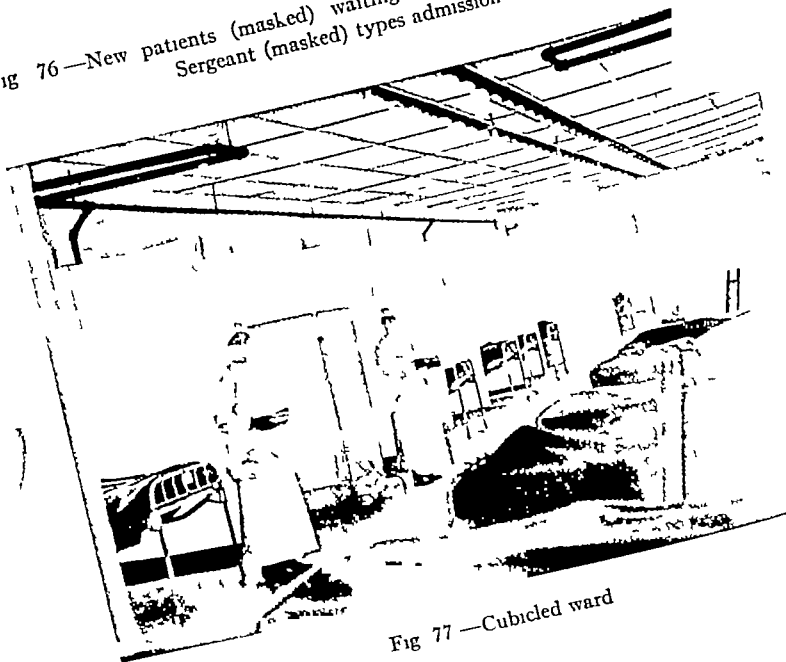


Fig 77—Cubicled ward

1 Routine Treatment.—*Service Orders*—The following Service Order for the treatment of all pneumonias was issued early in October

"Base Hospital, Camp Zachary Taylor, Louisville, Ky ,
October 12, 1917

ORDER No 6

MEMORANDUM ON ROUTINE CARE—PNEUMONIA PATIENTS

- 1 Push fluids—especially lemonade, orangeade, milk, and plain water
- 2 Tincture of digitalis, 20 minims each four hours, for three days
- 3 Open all windows near patient.
- 4 Give low cleansing enema P R N
- 5 For temperature of 104° F or over tepid sponge-bath each four hours
- 6 Codein sulphate, $\frac{1}{4}$ to $\frac{1}{2}$ P R N , for severe cough.
- 7 Temperature, pulse, and respiration each four hours.
- 8 1½ drams (7 c.c) 10 per cent. potassium acetate solution each four (4) hours.
- 9 In case of collapse or delirium or any untoward symptoms, call Ward Surgeon immediately "

With the progress and increase of the virulence of the infections, and in view of the postmortem findings of cardiac dilatation as the immediate cause of death, special attention was given to the use of digitalis. Through the courtesy of the Department of Physiology, of the University of Louisville, the various digitalis preparations on hand were standardized and the preparations of the highest potency were used as far as possible. The following memorandum regarding the use of digitalis was issued

"Base Hospital, Camp Zachary Taylor, Louisville, Ky ,
December 17, 1917

ORDER No 4

MEMORANDUM ON DIGITALIS

- 1 Tincture of digitalis (Squibb) should be started immediately on all lobar and bronchopneumonias as soon as

the diagnosis is established In cases of high temperature and clinical lung involvement without positive lung signs, digitalis should also be given

- 2 *Method of Administration* —In cases diagnosed early and without urgent cardiac distress, good pulse, and little cyanosis, give tincture of digitalis, 30 minims (2 c.c.) every six hours 9 00 A M, 3 00 P M, 9 00 P M, 3 00 A M for forty-eight (48) hours
- 3 If diagnosis is made late with great cardiac distress, marked cyanosis, dyspnea, etc, give 60 minims (4 c.c.) at 9 00 A M, 3 00 P M, 9 00 P M, and 3 00 A M. for twenty-four (24) hours
- 4 Digitalis should be measured out accurately in minim glasses
- 5 If digitalis is not absorbed as evidenced by no evidence of digitalization (slowing of pulse, improvement of general condition, breathing, cyanosis, and character of pulse), give ampules of digipuratum, strophanthin, or ouabain intravenously
- 6 If digitalis effect has been obtained, do not repeat until new evidence of cardiac failure If urgent, give intravenously, if not urgent, tincture by mouth in same as original dosage
- 7 If digitalis is not effective at any time and particularly in case of collapse, give camphorated oil, 15 to 20 minims, hypodermically, every half hour to two to four hours as indicated Caffein, 2 grains, and strychnin, $\frac{1}{10}$ grain, may likewise be given to asthenic, toxic, or collapsed patients if without delirium or central nervous system involvement
- 8 Venesection in marked cyanotic plethoric individuals with high, bounding pulse may in certain instances be of value
- 9 Oxygen tanks may be obtained in emergency from the Head Surgery Building "

December 20, 1917, in view of the rapidly increasing com-

plications in measles, Memorandum No 5, regarding the care and treatment of these cases, was issued

"Base Hospital, Camp Zachary Taylor, Louisville, Ky ,
December 20, 1917

ORDER No 5

MEMORANDUM ON CARE AND TREATMENT OF MEASLES CASES

- 1 Care on entrance into ward
 - Bed warm
 - Protection during giving of bath
 - Enema if bowels have not moved.
 - Cathartic pills.
 - Mouth, nose, and teeth hygiene
 - Specimen of urine to laboratory
- 2 Care during febrile and eruptive period
 - Semiliquid or soft diet.
 - Sponge-bath for temperature of 103° F or over
 - Push liquids—water, milk, diuretics
 - Medication for adequate rest, sleep, and control of cough
- 3 Care during decline of fever and convalescence
 - Full diet as soon as possible, nourishment between meals
 - Daily alcohol rubs
 - Prolonged rest in bed—getting up gradually in forenoon and afternoon.
 - Protecting clothing while getting up, not to put patient to work in corridors.
 - Sufficient food
- 4 Treatment of complications
 - Early diagnosis of pneumonia, with early digitalis therapy
 - Early diagnosis of otitis media, empyema, mastoid disease, etc.
- 5 Ventilation of ward
 - Temperature 65 to 70 degrees
 - Ventilators open.
 - Good air circulation
 - Windows open from top only

6 Care in transfer to other wards

Ample protection with blankets, litter or wheel chair, if unable to walk

7 Discharge from hospital

Minimum of twenty-eight (28) days

Back to normal weight

Seen by special examiner before discharge

Free from infective symptoms

Free from complications

Normal specimen of urine "

With the advent and segregation of the empyema cases a routine was established, covered in orders for the observation and care of these cases, and was published February 1, 1918

"Base Hospital, Camp Zachary Taylor, Louisville, Ky ,
February 1, 1918

ORDER No 15

MEMORANDUM ON TREATMENT OF EMPYEMA

- 1 Every bronchopneumonia and lobar pneumonia, severe sepsis, continued high temperatures without demonstrable cause, severe continued dyspnea, particularly when accompanied by a sense of marked discomfort or pain on breathing, fulness or tightness in the chest, shall be considered *potential empyema*, and be observed constantly with this possibility in view
- 2 Each potential empyema shall be x-rayed within forty-eight (48) hours of admission, providing patient's condition permits
- 3 Each potential empyema shall be seen by the special empyema surgeon within forty-eight (48) hours after admission for consultation regarding exploratory thoracentesis
- 4 A positive thoracentesis shall be followed immediately by potain, withdrawing as much fluid as compatible with patient's condition A specimen of such fluid each time obtained shall be sent to the laboratory for examination

- 5 Proved cases of empyema shall be examined daily, and x-rayed and tapped at least every third day. Upon the fluid becoming opaque and of cream or purée consistency, patient shall be transferred to Surgical Service for continuous drainage with suction apparatus, unless ordered otherwise."

2 **Withdrawal of Fluid**—In a large number of cases the withdrawal of even a small amount of fluid was followed within a period up to forty-eight hours with partial or complete collapse of the patient. The explanation of these cases may be sought in either the mechanical withdrawal of fluid or, in the acute stages, of an increased absorption of toxic and other septic products from the inflamed lung and pleural surfaces. To control this we have, within recent months, followed all withdrawals of fluid with injection of an equivalent amount of air or nitrogen gas. This is accomplished by either reversing the potain pump and pumping air into the chest or by the use of the Murphy pneumothorax apparatus. By such methods the pain and discomfort complained of shortly after or during the removal of fluid is very promptly relieved. The introduction of this air, or gas, acts as a buffer or support for the lung and pleura, and due to its gradual absorption in the course of a few days allows the lung to expand gradually.

3 **Time of Election for Surgical Interference**—By the middle of January we had reached the decision that early operation in empyema was a mistake and that delayed operation was the operation of choice. This conclusion was arrived at after many perplexing experiences and after considerable study, and was so stated in orders of February 1st, and published March 30th, in the Journal of the American Medical Association, as follows:

"5 The character of the empyema fluid gradually changes, becoming progressively more turbid and heavier. The greatest benefit from surgical interference is obtained by delaying operation until the fluid becomes opaque, greenish gray, and of cream or purée consistency. Operations instituted earlier or later are of less benefit."

More recently additional observations, based on analyses of the temperature, pulse, respiration, leukocytes, and blood-pressure curves, have been made, confirming our original belief

From an analysis of these curves in a series of over 90 cases the cases may be divided into three groups

First, simple fibrinous or serofibrinous pleurisy with sterile fluid or with none at all, and with prompt recovery within forty-eight to seventy-two hours after admission. These constitute about 20 to 25 per cent. of the cases analyzed

Second, true severe empyema, starting acutely with high temperature and chest pain, with rapidly developing fluid, passing through the three stages of serous, seropurulent, and purulent, the majority eventually recovering following surgical intervention. These constituted about 65 to 70 per cent. of the cases analyzed

Third, the foudroyant fulminant cases, probably general septicemia, entering with chests full of fluid and dying within forty-eight to ninety-six hours in spite of all treatment. These constituted about 10 to 15 per cent. of the cases analyzed

The first group of simple pleurisies with sterile fluid are characterized by the prompt permanent drop (crisis) of temperature, pulse, and respiratory rate, and the low white count (4000 to 5000)

The second and largest group of empyemas pass through a rather definite cycle of events, more or less similar in all.

The development of empyema in this group may be considered to occur in three stages, namely

Stage I Acute stage, preceding the development of pleural fluid

Stage II The development and demonstration of serous or seropurulent fluid

Stage III The development and demonstration of "creamy" pus

The temperature, pulse, respiration, and leukocyte count in these stages are as follows

Stage I Acute stage, preceding the development of pleural fluid

Temperature, 103°-104° F

Pulse, 110-112

Respiration, 34-36

Leukocytes, 12,000-15,000

Stage II The development and demonstration of serous or seropurulent fluid

Temperature, 100°-101° F

Pulse, 100-110

Respiration, 30-34

Leukocytes, 14,000-18,000

Stage III The development and demonstration of "creamy" pus

Temperature, 99°-100° F¹

Pulse, 100

Respiration, 30

Leukocytes, 20,000-30,000

Stage IV Following the development of "creamy" pus the leukocytes generally fall.

In general, with the onset and development of empyema the *temperature, pulse, and respiration fall*, the leukocytes *rise* (Chart IX). Synchronously, there is an abatement of the acute severe symptoms, and a clinical improvement in the patient's condition, which fact accords with the conception that pleuritis in these infections is evidence of good combative powers of the patient.

The pulse usually parallels the temperature and respiration, although it is often relatively rapid, that is, temperature of 99° F, with pulse of 110.

In the favorable cases there is apt to be some drop in the leukocyte count following each withdrawal of fluid, with a subsequent rise thereafter, coincident with the thickening and accumulating of pus.

In the fatal cases the pulse and respiration are of greatest importance, continuing to *rise*, although the temperature may

¹ About one-half the cases show a slight *secondary* rise in temperature as the pus thickens, although the pulse and respiration may remain unchanged or even drop.

fall (Chart X) Failure of the pulse to fall with the usual drop in temperature, and particularly an *increase* in *pulse-rate* through all three stages are almost certainly indicative of a fatal outcome

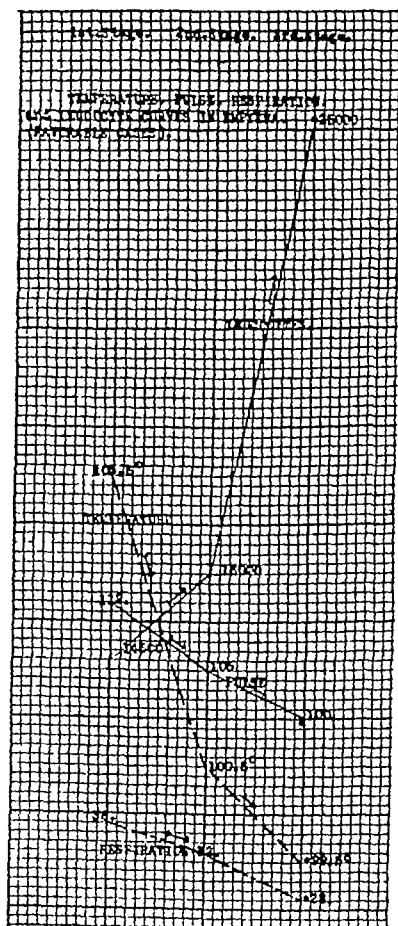


Fig 78—Chart IX. Note the fall of temperature, pulse, and respiration and rise in leukocytes in *favorable* cases of purulent pleuritis (*) Time of choice for thoracotomy at end of third stage (Contrast with Chart X)

The leukocytes, in fatal cases, may continue to rise after the establishment of thick pus The highest count obtained (70,000) occurred under such conditions

The blood pressure is of little value. There may be a slight increase in the seropurulent stage. There is little change in fatal cases.

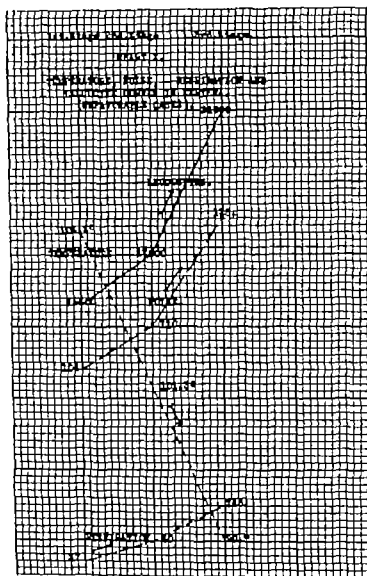


Fig 79—Chart X. Note the rise in pulse and respiration in *fatal* cases of purulent pleuritis. (*) Urgent indication for surgical interference. (Contrast with Chart IX.)

Time of election for surgery, four criteria

- A The establishment and demonstration of "creamy" pus
- B The lowest point in the temperature, pulse, respiration, and leukocyte curve (*after* the fall of the secondary rise in temperature and *before* any increase in pulse or respiratory rate)
- C The lowest point of the leukocyte curve, if possible,

waiting for the drop following the development of pus, *although failure to drop with rising pulse are urgent indications for surgery*

D In general, delaying operation as long as possible, providing the patient's clinical state is satisfactory, but not delaying too long, until secondary toxic symptoms develop *Probably the pulse-rate is of maximum value as a guide*

An additional surgical method advocated early in February was the use of continuous drainage with suction, either with a Brewer tube and Chapman water pump or some similar apparatus. A third factor of importance is the use of Dakin solution, which is being used in conjunction with intermittent drainage through the Brewer tubes.

4 Diet —A diet rich in utilizable carbohydrates was introduced early in April for the prevention, as far as possible, of the marked cachexia, which was so striking a fixture in the long standing empyema cases. However, such diets as well as several modifications, including the Coleman typhoid diet, were not very well accepted by the patients, the majority of them complaining of an overamount of sugar, sweetening, and other carbohydrates. It was finally found that practically each diet had to be adapted to the individual patient, but in general a diet rich in carbohydrates was found possible. Later protein was also increased, until finally a generous mixed diet containing from 3000 to 4000 calories became a routine on the convalescent empyema wards.

5 x-Ray —It is hardly necessary to speak of the inestimable value of fluoroscopic and plate examination in the early recognition of empyema. It is due to the x-ray that objective evidence of the extreme rapidity (within twenty-four hours) of the filling of the pleural cavity with pus was obtained. As a surgical guide for the location of pus, and for the diagnosis of complications in the postoperative cases, one cannot say too much of its value.

6 Convalescence (Disposition) —The factors of greatest importance during convalescence seem to be an adequate diet of rather large proportions, fresh air and sunshine, and very gradual return to activity, such as short walks, hikes, and drill. The value of fresh air was clearly demonstrated by the better-

ment of the bed patients by moving them from the ward to the porch. Late complications—such as septic joints, tuberculosis, and chronic abscesses—are not infrequent, and special measures in individual cases were taken. Of the 304 cases of pleuritis up to September 1st, 70 cases have died, 76 cases have been discharged from the Service, 18 cases have been accepted for Domestic Service, and 6 cases have been returned to full duty, 33 are still in the hospital. The decision as to the advisability of discharging these pleuritis cases is most difficult, as the majority of these patients, although entirely free from complaints, with normal pulse and temperature, and firm healing of the chest wound, without complications of any kind, often remain from 15 to 45 pounds under weight. Such cases we believe should be accepted either for Domestic Service, or discharged from the Service entirely. This conclusion is based on the fact that unless these patients have entirely regained their normal weight their resistance is low and they remain fertile soil for new infections. Second, although they may have regained their full weight, many complain of weakness and easily tire, and are not fit for full duty. Third, even though they may have completely recovered, these boys have already suffered very greatly in their military career (in the serious cases it has been a miracle that they have recovered at all), and it would seem that after six to ten months of hospital life, with the pain and discomfort and patience entailed therein, that these boys have already performed their full duty to the government.

VII. RECOMMEND MEASURES FOR FUTURE CONTROL

Camp—There is very little to add regarding measures for future control that have not been already spoken of. The establishment of a Detention Camp would seem to be the *sine qua non* for the ultimate control at the source of these infections. During this period the Detention Camp would separate all new recruits into measles immunes and non-immunes, into streptococcus carriers and non-carriers. In addition, during this period they could receive prophylactic vaccination against pneumonia and streptococcus, troops from the South examined

for hookworm and malaria (as it has been shown that such infections lower resistance and predispose to the more severe acute infections of large camps) The following memorandum, prepared April 18th, gives in outline the method of work in the Detention Camp

“Base Hospital, Camp Zachary Taylor, Ky,
April 18, 1918

ORGANIZATION OF DETENTION CAMP

Methods of Handling Draft Quotas

- 1 *Arrival of New Quotas of Drafted Men* —Leader of quota will turn over to Company Commander required mobilization papers Company Commander will prepare the identification card, lists of members of quota, service record, finger print card, 88 M D , and other forms for physical examination
- 2 *Physical examination* shall include
 - (a) General physical examination
 - (b) Typhoid and smallpox vaccination
 - (c) Listing and segregation into two large groups
 - Measles immunes
 - Measles non-immunes
 - (d) Swabbing of throats for streptococcus carriers and segregation, as soon as reports are received, into groups
 - Carrier
 - Non-carrier
 - (e) Prophylactic streptococcus vaccination

Note —These last two provisions could not be carried out for various reasons chiefly because the arrangement of the camp schedules, training, and detention could not be accommodated to them, nor was vaccination against streptococcus on a sufficiently sound basis to permit of its general use

- (f) Examination for hookworm and malaria and proper treatment of infected individuals

3 *Administration of Detention Camp*

- A Absolute quarantine for three weeks

- B High barb-wire fence around camp, with entrance and exit guards, day and night.
- C Absolute prevention of communication with civilian population, extra cantonment zones, and other portions of the camp
- D Absolute prevention of mingling in Y M C A., K. of C., Post Exchange, and latrines
- E Daily instruction in personal hygiene and spread of contagious diseases—Warn the men about lying on each others' beds or pillows, using towels, pipes, or other articles in common To wash their hands frequently so as not to convey any infection thereon to their air passages, no common drinking cups, boiling water for mess kits
- F Daily program for men to include
 - (a) Progressively increasing drill and hike schedules—starting very gradually, and adapted to the requirements of the *weakest* man in the outfit.
 - (b) *Twice daily*, inspections for early recognition and segregation of respiratory and contagious disease.
 - (c) Daily weighing of entire command, with inquiry into unusual loss or gain in weight."

Hospital.—Probably the two most important contributions which have been made relative to the control of these infections in the hospital are, first, the masking method, and second, the separation of incoming cases into streptococcus carrier and non-carrier cases The use of the mask has already been described The separation of incoming cases into carrier and non-carrier wards has been shown by Levy and Alexander at this hospital to be of distinct value They noted that the complications in measles occurred almost exclusively in the streptococcus carriers, the incidence in this group being 36.8 per cent., as contrasted with 6.4 per cent. in the non-carrier cases During the past two months similar separation has been made not only of all measles cases coming into the hospital, but likewise of all general medical cases, including the respiratory group of diseases These later

studies were made at a time when the incidence of respiratory and streptococcus disease was at its lowest point, and they show a very marked reduction in streptococcus carriers, as compared with carriers in epidemic conditions. For example, of 228 cases of measles coming into the hospital in July, 34.1 per cent were found to be carriers (Chart VIII), as contrasted with 77.1 per cent. during the month of March (Chart VII) (Levy and Alexander). Pneumonia developed four times, or 1.8 per cent, as against 12.1 per cent. in the early series, three of these, or 2 per cent, developing on the non-carrier wards and one case, 1.2 per cent, developing on the carrier wards, these figures contrast with 6.4 and 36.8 per cent respectively in the former series.

These figures are particularly interesting, showing that not only is the percentage of carriers markedly reduced (77.1 to 34.1 per cent) during non-epidemic periods, but apparently the virulence of the organisms themselves must be reduced as evidenced in the complications (12.1 to 1.8 per cent.) We find the same to be true in the general medical cases. Of 390 cases admitted during July, 140 were carriers and 250 were non-carriers, of the former, only one complication developed (0.7 of 1 per cent.) In the latter two lobar pneumonias (0.8 of 1 per cent). Undoubtedly such percentages would be different in times of epidemics, and it is proposed during the coming winter to inaugurate the same method of segregation at least among the respiratory cases. One word of caution is necessary in determining the value of this method, that is, to determine the type organism responsible for the complication (pneumonitis, pleuritis, etc), as the finding of streptococcus carriers in measles or general medical cases is not of itself sufficient to stamp the carriers of these cases as being streptococcal in origin. It is only necessary to point out that of the five pneumonias developing during July in the carrier wards, in which bacteriologic studies were made, in none of them could streptococcus be definitely determined, most of these cases being pneumonia, Type II.

Former publications from this camp by the writers and

Alexander and Levy would seem to imply that streptococcus infections are more likely to occur where there are streptococcus carriers. We would prefer to state now that it seems as if the streptococcus carrier state merely indicates in the winter months a probability that complications of some sort may arise

VIII. SUMMARY AND CONCLUSIONS

A review of the foregoing pages emphasizes the premises with which we started out, that we have experienced a group of epidemics composed of three variables which arose with the advent of draft men and waxed and waned through the first year of Camp Taylor. Generally speaking, two of the variables—pneumococcus infection and measles—presented, when considered by themselves, little or no variation from the former pictures of these diseases, but both were greatly influenced by the presence of a streptococcus infection which started early, assumed many forms, and acted as a superimposed infection upon the first two mentioned. The course of the three variables, as indicated by the charts, is not the same. The incidence of the pneumonias and measles was very much greater during the early period, whereas measles, pneumonia, and streptococcus infections were the dominant features of the late period.

The outstanding clinical phases and pathologic processes of the epidemic are, first, pneumonitis, and second, pleuritis. The pneumonitis produced by the pneumococcus was of the ordinary picture and that of the early cases of measles pneumonia was similar to inflammations of the lung seen in measles before the war. When, however, the influence of the streptococcus was felt, the measles pneumonia assumed peribronchial and diffuse hemorrhagic forms which led to pleuritis. It would seem also that the streptococcus attained some form of virulence or adaptability that permitted a rapid spread of the organisms to the serous surfaces, because in the spring there were cases of primary polyserositis without the pneumonias aforementioned. Not only did the streptococcus have the power of complicating these measles, but it sometimes acted as a member of a mixed infection with a pneumococcus. The effect of the streptococcus

was not only felt in measles, pneumonitis, and pleuritis, but there were also many infections of the ear and sinuses of the head, cases of erysipelas, cellulitis, and other comparable manifestations. A study of these other effects of streptococcus has helped to elucidate the origin and course of the epidemic.

The high point of morbidity appeared in the early spring, after which all the variables declined rapidly due to improved hygienic conditions and weather, and possibly to reduction of virulence, it was probably not due to lack of available material because new men were coming in all the time. There is, however, in reviewing the charts a rough relationship between the advent of draft men and the rise of case incidence due to the three variables.

The origin of the epidemic can be explained on the basis of the collection of a large number of non-immunes because the percentage of arrivals from the rural districts is largely in excess of that from urban. The inception of the epidemics seems to have taken place in the Depot Brigade, the gateway of entry to the camp, where non-immunes under strange and trying circumstances are first exposed to the contagion. Naturally, the attack upon this series of infections began in this area and took the form, first, of attention to personal hygiene, second, to barracks hygiene, third, to regimental hygiene, and fourth, to the daily medical inspection of all possible contacts. The attack upon an infection in the hospital took the form of separating suspected infectious cases from general medical and other cases, both in the receiving ward and within the wards themselves, by the use of cubicles and masks.

We believe that the advent of new infections to the camp can only be controlled by an adequate detention system and sick inspection, that is, seeing every man of the command every day in order to determine whether he is in the incubation period of a disease, since we know that for various reasons sick men are not detected soon enough to give them adequate care or to protect their fellows. It would be well if all immunes and non-immunes could be segregated and if all individuals could be inoculated against streptococcus and pneumococcus diseases. A

very important factor is the arrangement of training schedules so that new arrivals at the camp can become accustomed to their surroundings and training gradually. This is particularly true in winter time when the human body is taxed to its limit to accommodate itself to weather conditions.

We wish to call particular attention to a few facts of clinico-pathologic value. It has been said that there is no hard and-fast rule upon which to make a decision to operate in cases of empyema. At this hospital we have found that the best time to operate is when the fluid has become creamy, the temperature, pulse, and respiration falling, and when, after a steady rise in leukocytes, there is a tendency to fall.

We wish also to record 3 cases of multiple pneumococcus determination in the sputum. Two of these examinations were made by a man of unquestioned ability, the third by a reliable enlisted man.

In the presence of a measles epidemic, particularly when complications are numerous, it would seem well to make cultures from the nasopharynx for the presence of hemolytic streptococcus because there is a very definite relation between the percentage of streptococcus carriers and complications. These need not be streptococcus complications. By this means one can segregate the carrier and non-carrier cases, a measure that seems to have prevented cross infections.

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THE PATHOLOGY OF THE STREPTOCOCCAL PNEUMONIAS OF THE ARMY CAMPS

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DURING the winter and spring months of 1917-18 there occurred a wide-spread epidemic of a fatal form of pneumonia, especially in the army camps, although affecting also the civilian population in many places

Study of this disease as reported from a large number of these camps has led to a fairly unanimous opinion that it is commonly although not invariably a sequel of measles, that it is not lobar pneumonia due to an infection with the pneumococcus, but rather a form of bronchopneumonia caused by a streptococcus, and that it is accompanied in an extraordinarily large proportion of the cases by pleurisy, with abundant effusion or empyema

The present writer had the opportunity of studying many of these cases while serving on commissions sent out by the Surgeon General of the Army to Fort Sam Houston in Texas and to Camp Dodge in Iowa. The details of these studies have been published elsewhere and have shown that the pneumonia is not all of one type, but that in any series of cases a considerable number are caused by the pneumococcus and are really cases of typical lobar pneumonia. The number of cases of this sort is dependent to a great extent upon the season and character of the weather, and is, indeed, not appreciably different from what might be expected in the absence of the main epidemic.

But the predominant affection which brought the figures by which the incidence of the respiratory disease in the camps is recorded up to the proportions of a true epidemic is a quite

different thing, and has been in our experience shown to be caused by a hemolytic streptococcus

This disease has been especially prevalent in the camps situated in the southern states and has raged particularly severely among recruits from the very isolated rural population of those states. So true is this statement that if the camps are plotted on a map according to the source from which they drew their recruits, as was done in the office of the Surgeon General, all of those most severely affected are found to lie in the South.

In the same way the extensive epidemic occurrence of measles is in the South among the same troops. Thousands of cases of measles have occurred, and the epidemic pneumonia of which we speak presents itself as a definite sequel of measles.

It is true that it may follow other diseases, such as scarlet fever or German measles, but the importance of true measles in this regard is paramount. It is also true that having once established its virulence and ready infectivity, the streptococcus may proceed to infect great numbers of men independently, and at Camp Dodge we were impressed with the fact that there had been very little measles, and that very well isolated, so that the great epidemic began in the camp apparently without dependence upon that disease. When it did occur in the measles barracks at the end of the epidemic it was far more rapidly fatal there.

Anatomically the pneumonia caused by the hemolytic streptococcus takes two forms—either it is essentially a bronchopneumonia in which extensive processes of organization and induration are rapidly developed—a form which we call interstitial bronchopneumonia, or it is a lobular exudative inflammation in which no such evidences of any powers of resistance are to be found. In both cases it is accompanied by empyema and by a few other changes especially in the upper respiratory tract.

In the history of medicine there are recorded numerous epidemics of pneumonia, beginning with the early part of the sixteenth century. They spread over Italy, Spain, France, Germany, and other countries, always involving great num-

bers of people with a very high mortality among those affected. It is difficult to recognize with certainty the types of pneumonia in these early epidemics, but the descriptions are so emphatic as to the frequent existence of empyema that it suggests the streptococcal rather than the pneumococcal form of infection.

In America similar outbreaks are recorded from the eighteenth century, and during the war of 1812 there was a great epidemic which spread among the troops in northern New York, and later among civilians not only in New York and the New England States, but throughout all the southern states. It lasted until 1815 in the North and dragged on until 1826 in the South. The descriptions of clinical symptoms and of some postmortem examinations lead one to believe that this was an affection quite like that which we have encountered during the past winter, even though some of the cases have greater resemblance to lobar pneumonia.

In the war of the rebellion, as recorded by Woodward and others, measles was extremely prevalent and was commonly followed by a form of pulmonary affection which was often described as bronchopneumonia and as associated with empyema. There were more than 61,000 cases of pneumonia during the four years of the war, and of these a large number was separated as related in some way to measles. More than a hundred postmortem examinations are recorded, and one surgeon had the happy idea of preserving three specimens of lungs from these cases in the Army Medical Museum in Washington. The authorities there kindly gave me permission to study these specimens which had stood in alcohol for fifty four years. They showed plainly the gross appearances which had become familiar in the study of the streptococcal bronchopneumonia of today, and in microscopic section still stained pretty well and presented lesions identical with those of the cases in the epidemic of last winter. Bacteria stained in these sections as brightly as in any modern tissue, and one could recognize streptococci in typical chains in the bronchi and pleural exudate.

In reviewing the cases met with in the army camps already

mentioned it was found that they fell into several classes. There were two predominant organisms concerned—the pneumococcus in its various types and the hemolytic streptococcus. Corresponding with these etiologic agents, there were pure cases of lobar pneumonia, on the one hand, and on the other far more numerous cases of interstitial bronchopneumonia and lobular pneumonia. In addition, there were combinations of these lesions, and it was not uncommon to find that the streptococcus had invaded the lung of a person who had a well-developed pneumococcal lobar pneumonia and had overgrown and supplanted the pneumococcus, or even that lobar pneumonia with living pneumococci and bronchopneumonia with abundant streptococci might occur side by side in the same lung.

It is not necessary to discuss here the cases of lobar pneumonia following infection with the pneumococcus, since these showed no especial peculiarity. They will, therefore, be mentioned only in so far as they occurred in combination with the streptococcal infections.

The streptococcal forms of pneumonia are spoken of definitely as such because of the fact that in every case which we studied the *Streptococcus hemolyticus* was isolated from the sputum, and pleural exudate before death and from the heart's blood, lungs, pleural fluids, pericardial exudate, and various other lesions after death. Ordinarily they were in pure culture, although in a great many cases the influenza bacillus was found in the sputum, and occasionally even in the lung and pleural exudate. This is one fact which may throw doubt upon the actual significance of the streptococcus in the minds of some, especially since several English writers have recently reported in France and England epidemics of a similar bronchopneumonia without much pleurisy, in which they obtained the influenza bacillus in pure culture from the sputum and occasionally from the smaller bronchi. Others in this country have found a non-hemolytic form of streptococcus. The fact that we have found the influenza bacillus in the tissues in only two cases and a definitely hemolytic streptococcus in every one, demonstrable in great numbers in immediate relation to the

lesions in microscopic sections, makes us believe that, after all, it is the really important element in the causation of the disease.

Little need be said in a paper on the pathology of the streptococcal pneumonia of the clinical signs and symptoms. The patients usually start a few days after the onset of measles, or a few days after convalescence from that disease, with a pain in the chest, sore throat, cough, a chill, high fever, and general malaise. The physical signs are indefinite, but there is usually some vague dulness over the chest and râles are heard scattered widely throughout both lungs, especially at the bases and behind. The patient becomes dyspneic, the respiration being especially labored in inspiration, cyanosis of a curious livid type appears, and there is a great deal of nervous excitability and apprehension. The dyspnea produces extreme discomfort and the most violent inspiratory efforts are made, bringing into play all the accessory muscles, this makes sleep impossible. The eyes are bright and shining, the mind most alert and filled with dread.

After a few days' dulness or flatness over the thorax becomes apparent and an exploratory aspiration reveals the presence of turbid fluid in the pleural cavity. The accumulation of this takes place with extreme rapidity, and it is replaced when removed in a surprisingly short time.

Delirium is not uncommon, and death often occurs after ten days or two weeks of such illness, although in some cases the whole course of the disease from the onset of the bronchial symptoms to death was only four or six days. Hoarseness or complete aphonia is especially characteristic of the cases which develop most rapidly and intensely after measles, but it sometimes occurs in those who have not had that disease.

At autopsy in the cases in which death has occurred a few days after the onset of the disease the pleural cavities are often found to contain no excess of fluid and their surfaces are smooth and glistening. In the great majority of the cases, however, there is present a considerable amount of exudate in at least one pleural cavity, sometimes in both. The pleural surfaces

are sprinkled with small petechial hemorrhages, especially over the back of the lung, and covered with a thin rough exudate of fibrin. In such instances the fluid is thin and watery, turbid and brown or greenish brown, with a granular sediment easily stirred up from the bottom and many floating shreds or flakes of fibrin. It is swarming with the streptococci in chains usually unmingled with any other organism. In cases which have run a longer course the fibrin on the surface is thick, yellow, and shaggy. There are often to be found adhesions between the lobes, between the lung and the costal pleura or diaphragm, or in such an arrangement as to separately enclose a space between the mesial surface of the lung, the pericardium, and the diaphragm. There the fluid exudate is distinctly purulent in character and either opaque greenish yellow or brownish gray with a slight blood-staining. The disposition of the adhesions often allows of the encapsulation of pockets of this pus between the lobes or elsewhere, especially often in the situation above described between the lung and the pericardium. Incision into the surface of the lung shows that the pleura itself has become greatly thickened by being converted into a layer of granulation tissue which tends to organize and replace the fibrinous exudate. The rapidity with which this organization occurs is surprising. When the pleura has been evacuated by operation the character of the exudate and the thick layer of granulation tissue upon the surface is unchanged, unless secondary infection has occurred, when the pus may become exceedingly foul.

The effect of this great accumulation of exudate in the pleura, which may amount to one or two liters or more, is to cause the extensive collapse of the lung, which appears as a blue pasty mass of tissue plastered against the mediastinal tissue. This is not the only cause of collapse, however, since obstruction of the bronchi plays a part, and it frequently appears in parts of the opposite lung even when there is no exudate in that pleural cavity.

The lung is, in general, flabby, but there may be felt throughout its substance nodules or larger areas of consolidation. The bronchi exude a thick brownish purulent exudate, and the

bronchial glands are enlarged and soft. On section the lung itself presents in different cases a very great variety of appearances. Those which form the anatomic complex of interstitial bronchopneumonia may be described first and afterward those of which we have spoken as lobular pneumonia, although it must be remembered that they are very frequently combined.

In the early stages of interstitial bronchopneumonia there is already a patchy atelectasis of the lung, the bronchi are filled even to their smallest branches with opaque yellow pus and are surrounded by a halo of hemorrhage. Otherwise the lung substance is air-containing in part and in part edematous. In all cases the hyperemia of the tissue is very striking. In such early cases microscopic examination shows the bronchioles filled with polymorphonuclear leukocytes and streptococci often in tangled masses ranged along the wall. The lymphoid tissue in the bronchial wall is slightly swollen through an increase in the number of its lymphoid cells. The adjacent alveoli are filled with blood and contain a few leukocytes.

Somewhat older cases show on section numerous firm projecting nodules throughout the lung, which on close inspection are found to be cross-sections of bronchioles with surrounding consolidation. If the bronchioles happen to be cut longitudinally, these condensations of the tissue appear not as nodules, but as very thick walled tubes further surrounded by a mantle of consolidated lung tissue. The area to which such a bronchus, obstructed as it is with a mass of purulent exudate, should supply air is collapsed completely. The consolidation is scarcely in this area, but rather in the alveoli adjacent to the bronchus. These too may sometimes be surrounded by hemorrhage, but usually that is only in the freshest cases. Viewed on cross-section the tiny bronchiole with its thickened wall and surrounding area of consolidation projects like a tubercle from the cut surface. Indeed, it is probable that when these are fairly small and uniform they have often been mistaken for miliary tubercles. As they increase in size they become more and more nearly confluent, and the intervening tissue shows a viscid edema which drives out its original content of air. In

time quite extensive areas show a patchy irregular consolidation through the coalescence of such peribronchial areas

Microscopically the bronchial wall is still found to be the part most intensely affected, the streptococci are present in the purulent exudate in about the same numbers, much of the epithelium is found to be desquamated, and in some cases of most intense infection the whole lining of the bronchus is necrotic and coagulated, and appears as a diphtheritic pseudomembrane. The wall of the bronchus is greatly thickened and densely infiltrated with mononuclear cells of the type of lymphoid cells, with some larger forms. It is probable that much of this represents a hyperplasia of the lymphoid tissue normally found scattered in the wall and condensed at the angles of division. This is especially indicated by the peculiar course of the blood vessels in this cellular tissue, which is that of the blood-vessels of the lymph-nodes. But much of the thickening of the wall is due to actual new formation of connective-tissue cells, to edema and hyperemia, and to a true infiltration of wandering mononuclear cells. It assumes the appearance in many cases of a richly vascular granulation tissue in which the new blood vessels are radially arranged, and in which, in the case of larger branches, remnants of mucous glands are to be found. The infiltration with mononuclear cells extends to the walls of the adjacent alveoli, which are thereby much thickened. These alveoli contain a dense exudate which is no longer composed of blood, but of desquamated epithelial cells, mononuclear cells, and solid plugs of fibrin. Further out the fibrin is replaced by fluid which appears to be especially thick and viscid. No streptococci are to be found in the substance of the bronchial wall or alveolar walls, nor even in the exudate in the alveoli. They are present, however, in abundance in the lymphatic canals which run in the bronchial walls, and there they are entangled in a thrombus mass which includes also many mononuclear cells. Such lymphatics extend in this thrombosed condition throughout the lung and communicate, on the one hand, with the sinuses of the lymph-nodes at the hilum of the lung, on the other with the network of lymphatics in the pleura. It

is thought that it is through them that infection extends from the bronchi to the pleura. This is against the natural current of the lymph, but the organisms extend by growth along the obstructed lymphatic canals.

The blood vessels are not thrombosed nor otherwise altered except that their adventitial tissue is densely infiltrated with cells. This, again, may be partly due to hyperplasia of the normal lymphoid tissue, especially since such infiltration after extending outward from the bronchial walls fades away in the alveolar walls until one approaches blood vessels or interlobular septa when it increases again.

The interlobular septa are greatly widened and most conspicuous on the cut surface of the lung. This is due, first, to their infiltration with fluid cells and fibrin, which later becomes replaced by connective tissue, and second, to the presence in their course of lymphatic canals which are thrombosed and distended with opaque yellowish white material. Such thrombosed lymphatics stand out on the cut surface of the lung running to the pleural network as huge opaque beaded strands sometimes large enough to be mistaken for bronchi.

Finally, the organization of the exudate in the alveoli and in the bronchi and its replacement by strands and columns of connective tissue ultimately clothed in alveolar epithelium forms a striking feature of the late stages of this process. The thrombosed lymphatics are similarly converted into solid vascularized cords of fibrous tissue, which must indicate the need for a most extensive new formation of lymphatics if absorption from the pleura is to be resumed. Then, as described above, the pleura itself becomes a thick red velvety layer of granulation tissue through the organization of the overlying fibrin.

The restricted distribution of the streptococci is most interesting. They are found in the bronchi, in the lymphatics, and in the pleural exudate, where they are limited pretty sharply to the surface layer of the fibrin and the fluid. The whole process indicates their inability to invade the tissue proper, and shows that the body is offering a strong resistance and erecting massive barricades against their entrance.

All this is quite different in the second form of the pneumonic process, which we have designated "lobular pneumonia". In these lungs there are found patches of consolidation associated with wide zones of hemorrhage, but in no such regular relation to the bronchioles as has just been described. These patches may be terminal, occupying the area supplied by a bronchiole, or they may be confluent and large enough to occupy one or several lobules, sometimes they have the granular appearance of the cut surface of a lobular pneumonia, but more often they are elevated, dry, dull and opaque, and thickly surrounded by dense hemorrhage. There is no especial thickening or prominence of the bronchi. The interlobular septa are not necessarily prominent and often the pleura is but little thickened. The lymph-channels are, however, thrombosed and very large and conspicuous in many cases. Microscopically it is found that there is no remarkable change in the bronchi except that they are full of purulent exudate and blood, but all the alveoli in the area are packed tightly with leukocytes in a network of fibrin, and among these leukocytes and often enclosed within them there are great quantities of streptococci uniformly scattered throughout the alveolar contents, a condition totally at variance with that found in the interstitial bronchopneumonia. The alveolar capillaries are sometimes occluded by hyaline fibrinous thrombi. Whole areas of such consolidated and intensely infected lung become necrotic, and it is especially about such patches that extensive hemorrhage occurs. In these necrotic patches the streptococci grow out into long chains which form a dense tangle.

It must be said that small areas of such exudation into the alveoli with abundant streptococci are quite often found in the most intense and acutely developed lesions of interstitial bronchopneumonia constituting a combination of the two lesions. The explanation of the existence of two such distinct types of reaction to the invasion of the streptococcus is not entirely easy. It seems very similar to the condition in tuberculous infection of the lung. In one case we may have a few tubercle bacilli setting up the formation of tubercles, tuber-

culous invasion of the lymph-channels, interstitial induration, etc., while in another case, or later or earlier in the same case, there is a sudden exudation into a whole area of pulmonary tissue, and the production of a gelatinous and caseous tuberculous pneumonia with great numbers of bacilli and rapid destruction of the tissue. It must be due to a remarkable difference in the power of resistance to invasion on the part of the tissues. Kraus has written lately suggesting the probability that this sudden invasion of the tissue by bacteria which were formerly held within bounds is due to a sensitization of the tissue by the previous infection. Possibly the same explanation might hold in this case, although the whole process occupies a very short time. At any rate, that seems to be another way of expressing the idea that resistance in one case is strong, in the other almost absent.

In the cases of lobular pneumonia great areas of necrotic tissue often become coagulated, opaque, and yellow, and appear as abscesses which may occupy a large part of a lobe. This is not limited to the obvious cases of lobular pneumonia, but sometimes occurs in those in which interstitial changes are prominent. The liquefaction of this material and its discharge through a bronchus leaves a ragged cavity which may in some instances through forming a communication with the pleura set up a fistulous connection between the pleura and a bronchus.

Of complications in other parts of the body there is relatively little to be said. The upper respiratory tract through which the infection occurs is everywhere infected. The pharynx is usually reddened, the tonsils not enlarged, but containing in their crypts abundant streptococci. The uvula, pillars of the fauces, pyriform sinuses, and edges of the epiglottis, as well as the aryteno-epiglottic folds, and *par excellence* the vocal cords are subject to streptococcal invasion and ulceration. Edema and a phlegmonous inflammation of these regions with myriads of streptococci in the tissues are observed. The vocal cords are often quite deeply ulcerated throughout their whole length with streptococci in great numbers strewn in the base of the ulcers. This is the reason for the hoarseness or complete loss

of voice which was mentioned. The trachea is reddened, but not ulcerated. The cervical lymph-nodes along the trachea are enlarged. Otitis media occurs sometimes through extension along the eustachian tube.

Pericarditis with effusion of purulent fluid and fibrinous exudate replaced later by adhesions is not very uncommon, and in some cases leads to enormous distention of the pericardial sac. Peritonitis was observed several times and appears to be due to extension of the infection through the diaphragm by way of the thrombosed lymphatics.

There were no especial changes in the abdominal organs which could be definitely associated with this disease. The testicles showed a cessation of spermatogenesis, the tubular epithelium being reduced to a single layer of spermatogonia and Sertoli cells.

Abscesses in the body musculature are sometimes seen, and I have heard of infections of the joints, although none occurred among the cases studied. Hyaline degeneration of the muscle-fibers of the rectus abdominis is rather common, as in typhoid fever, and sometimes leads to symmetric rupture of those muscles, with the formation of hematomata. There has been much discussion as to the existence of a definite septicemia in these cases, and we can only say that blood-cultures have been negative except when taken a short time before death. A few organisms may enter the circulating blood, but there seems to be no typical septicemia.

Combinations of streptococcal interstitial bronchopneumonia with lobar pneumonia have been mentioned, and in these cases the two lesions remain fairly separate and overlap but little.

To summarize, it may be said that an extensive epidemic of pulmonary disease has resulted from wide-spread infection with a hemolytic streptococcus which invades most readily upon the basis of a predisposing attack of measles.

This produces inflammatory and ulcerative changes in pharynx and larynx and, extending to the bronchioles, sets up a bronchopneumonia which may in persons of poor resistance

take the form of a lobular pneumonia with extensive spread of the organisms and rapid necrosis, or in those with better powers of resistance produce a purulent bronchitis with great thickening of the bronchial walls and consolidation of the adjacent pulmonary tissue, infection of the lymphatics, and thence of the pleura. Induration of the framework of the lung and organization of the exudate tend to limit the process. In both types pleurisy with abundant effusion is very common.

FUNCTION OF A BASE HOSPITAL IN A NATIONAL ARMY CANTONMENT

BY LIEUT -COL. CHANNING FROTHINGHAM, M C , U S A
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IN order to appreciate just what part a base hospital plays in the medical work of a large army cantonment one must have a mental picture of the problems presented to the medical corps in one of these camps. The base hospital in a cantonment is a part of the command under the general in charge and, therefore, intimately connected with all the camp problems. One should also bear in mind that the name of base hospital applies to other hospitals of the medical department than those situated in a cantonment. The problems presented to these other base hospitals may be quite different from those met in a cantonment.

The problems presented to the medical department of the army in a cantonment may be grouped as follows

The physical examination of officers, nurses, soldiers, and drafted men.

The care of the sick and wounded

The prevention of disease

The advance of medical knowledge and science.

The articulation of the camp medical work with the Surgeon General's office.

As the organization of the medical work in the various cantonments has, in a certain measure, been left to the local authorities in the cantonments, there is naturally some variation in the work assigned to the hospital in the various camps, but it is surprising to see how similar the work is in all the essential features. Although the primary function of the base hospital is the care of the sick and wounded, many of the other medical problems of the camp are carried out, in part at least, by the base hospital

The base hospital staff must be prepared to make the routine physical examination of officers and nurses, as all reporting to the hospital for their first station must have a physical examination. Furthermore, for various other reasons, such as promotion or discharge, the routine physical examination has to be completed by the base hospital officers. Although the routine examination of the recruits is carried out under the supervision of the camp surgeon by medical officers not attached to the base hospital, there are certain special cases which are referred to the hospital staff. These are the cases which require special apparatus for investigation, or the advice of a specialist, such as the otologist, roentgenologist, or ophthalmologist. It becomes, therefore, the function of the base hospital during the examination of a fresh increment from the draft to be prepared to help out the examining board on these special cases.

Intimately associated with the physical examination of soldiers is the determination by medical officers of a soldier's physical fitness for duty following some injury, or illness, or the wear and tear of active service. It has been found convenient in many camps to have the medical officers for this board chosen from those on the staff of the base hospital and to have the meetings of the board held at the base hospital.

The base hospital must be ready to take care of any or all of the sick or injured from the camp. As it is the custom to send to the hospital all cases of acute infection from a common cold to the most serious cases, it may receive without any warning a large number of patients for admission. It is conceivable that during an epidemic the base hospital will be unable to handle all the cases sent to it, but it must be prepared to expand as much as possible if the camp surgeon decides it is advisable to crowd cases into the hospital rather than to treat them elsewhere. The cases for the hospital are picked out by the regimental surgeons at what is known as "sick call." No attempt for careful differential diagnosis is made at sick call, as all the opportunity offered the regimental surgeon at that time is a chance to pick out the cases which should be sent to the hospital.

The hospital, therefore, must be prepared, in receiving the

patients, to send them to the appropriate services which will be specially prepared to care for the various diseases. The receiving officer must also be prepared to separate the contagious cases if any such should appear. For the care of this great variety of disease the government has provided an excellent equipment, especially for the study and treatment of acute disease. In addition to providing a good equipment, the government also has arranged that the staffs of these hospitals will be well supplied by specialists. It is, therefore, the duty of the base hospital in a cantonment to employ every aid in diagnosis and treatment of disease that can be employed by the ordinary clinician or the specialist.

The base hospital in these camps must also be prepared to follow up the convalescence of a patient for a longer period than is customary in civilian hospitals, because from the hospital the soldiers are sent to duty and must be ready soon to undertake hard work. In order to care for them in this period the hospital has a special group of convalescent patients who have graded exercises and instruction. Eventually many of these hospitals will have some sort of occupational therapy to help fill up the time of these soldiers.

At the base hospital is situated the morgue, which is under the immediate direction of the chief of the laboratory service. This morgue cares for the bodies of those who die in the camp or surroundings, as well as those who die in the hospital. The handling of the bodies of a large number of deceased soldiers at one time becomes a problem of considerable magnitude and importance for the base hospital.

The impression perhaps created that all sick and convalescent soldiers are treated in the base hospital in a cantonment is not entirely correct, for a certain number of venereal cases are handled in the infirmaries of the various organizations. Also in the Depot Brigade of the camp there are grouped certain soldiers in what is known as the Development Battalion, and certain of the convalescent patients may be referred to that group.

Even in a cantonment the problem of transportation of the

sick and wounded, which is such an important factor in the field, requires considerable attention. It may fall entirely to the hospital to maintain the ambulance service for the camp, or this work may be carried out by the ambulance companies situated elsewhere in the camp. In the latter case the hospital will probably be called upon to maintain an ambulance service for some part of the twenty-four hours at least.

To insure the army against disease as much as possible the medical department endeavors to keep the causes of disease away from the soldiers and to increase their resistance against certain diseases by vaccination. To keep disease away from the soldiers rules in regard to hygiene, sanitation, and isolation are established by the Surgeon General's office and modified by the Camp Surgeon to suit the local conditions. The base hospital's function in regard to hygiene and sanitation is simply to see that the rules of hygiene and sanitation are enforced in the hospital and its surroundings, and among the enlisted men, nurses, and officers of the command. In regard to isolation of carriers of disease germs the hospital plays a more important part, for it is in the laboratory of the base hospital that the cultures are taken to determine the presence of carriers. When a case of diphtheria or meningitis, for example, occurs in a barracks all the men in immediate contact with that soldier are sent to the laboratory and cultures from their noses and throats taken. All the carriers found among these men are isolated at the base hospital.

The vaccinations against disease are made in the infirmaries of the organizations to which the soldiers belong at entrance, but the base hospital must be prepared to carry on these inoculations on its own command and, in cases of emergency, for soldiers of other organizations. Two other important customs in the army to prevent the spread of disease are the physical examination of soldiers twice a month to the extent of inspection of mouths, skin, and genitalia, and the prophylactic treatment after exposure to venereal disease. The base hospital, of course, carries out these customs in regard to its own detachment of soldiers.

The base hospital has an excellent chance to advance medical science by the opportunities offered for investigation. The opportunity for autopsies in the army is greater than in civil life, so there is plenty of pathologic material for study and, therefore, the chance to thoroughly complete the observations on a given problem is not blocked as it so often is in civilian hospitals. The government, by its policy of well equipping the laboratory, offers a splendid opportunity for special investigations and research in the laboratories at these base hospitals. The opportunity to make a careful clinical study of cases is excellent in the army, as the patient is always under control, and cannot slip away from observation before the case is completely studied or the desired treatment properly carried out. A base hospital in a cantonment is not doing its duty unless it adds something of value to the medical literature.

In addition to producing original medical work, the base hospital should act as a graduate school of medicine for medical officers who have not had the opportunity to keep abreast of the advances in modern medicine. For this purpose the base hospital should arrange for clinics and courses of instruction for its officers and other medical officers in the camp.

The establishment of a branch of the Army Nurses' Training School in most of the cantonment base hospitals shows the demand upon these hospitals to do their share toward the development of trained female nurses. In addition to the training of female nurses, the base hospital must develop the men of its own detachment to perform the various duties assigned to them. The development of good ward masters is especially important.

Should any part of the medical department become detached or isolated from the whole structure, its efficiency would be seriously impaired. The connecting link between all the different units of the medical department is the Surgeon General's office, and the so-called "paper work" of the army is the medium of communication between the various units and the Surgeon General's office and each other. In order to articulate smoothly with the Surgeon General's office the base hospital

must see that its reports and records are sent in accurately and on time. The importance of this is further exaggerated when one realizes that from these reports information of inestimable value is furnished in regard to statistical studies upon the prevalence, course, and treatment of disease in the army.

In this hasty sketch of the function of a base hospital in a National Army Cantonment an attempt has been made to give an idea to the civilian physician what type of work a physician is called upon to do who is assigned for duty at one of these hospitals. The point which should be emphasized is that, in addition to the actual diagnosis and treatment of the sick, there are many other duties which must be well carried out in order to make the hospital properly fulfil its function.

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RESULTS OF THE EXAMINATION OF 23,943 DRAFTED MEN BY THE CARDIOVASCULAR BOARD AT CAMP JACKSON, COLUMBIA, S C

BY MAJOR EDWARD H GOODMAN, M C , U S A

DURING the months of June and July there have been 48,844 draft men examined at Camp Jackson. For a time the heart and lung examinations were within the province of the tuberculosis board, but recently a cardiovascular board has been created which has relieved the tuberculosis board of the responsibility of the cardiac cases. The system in force at Camp Jackson seems to be admirable in many respects. The recruits are first examined by the pulmonary board, and in this way a common cause for tachycardia is detected, making the interpretation of these difficult cases a somewhat easier matter.

The cardiovascular board consists of five teams, of two men each. These two men are termed "Routine man" and "Reject man," the routine man and the reject man both doing routine examinations, but the reject man alone having the authority to reject cases. He is chosen for this office because of his experience and judgment, and when there is a case which, in the opinion of the routine man, is a borderline case, the recruit is referred to the reject man, whose decision may be final, but who has the privilege of referring these cases to the president of the board, whose decision must be final. All such cases, whether they prove to be definitely normal or abnormal, are taken up on the special government form, on which is a record of the history and physical examination. A clerk who has been carefully instructed in history taking relieves the reject man of much of the paper work, and much time is saved thereby.

All cases rejected or accepted must have a form made out, and since assuming charge of the board I have had duplicate histories written for all accepted cases. The reason for this will be apparent, as, so long as the recruit remains at Camp Jackson, we have a record of his physical examination at the time of his acceptance for military service, to which to refer should the man be referred to the board from sick call, as is often the case. This system has been particularly useful recently during the time men were being examined for overseas duty, as we were able to check up on the cases which had a short time previously passed through our hands.

Since June 22d these duplicate histories have been collected from the accepted referred cases from a grand total of 23,943 men examined since that time

A	Total number examined	23,943
B	Number referred to reject men	656
C	Total number of B accepted	350
D	Total number of B rejected	306

Percentages

1	Per cent of B to A	2.3 per cent
2	Per cent of C to B	53.3 "
3	Per cent. of D to B	46.6 "
4	Per cent. of C to A	1.4 "
5	Per cent. of D to A	1.2 "

It will be seen from the above figures how efficiently some of the draft boards are co-operating in this work, and it is a record for them to be proud of that only in 2.6 per cent of all the cases was there any doubt about the physical condition, and that only 1.2 per cent were found to be unfit for military service.

The table on page 401 shows the diseases encountered, their number, the incidence of the disease or defect in 23,943 men, the number of each disability that was accepted or rejected, and the percentage of acceptance or rejection to the number of cases exhibiting that disease. Our rules for rejection were strictly interpreted, and inasmuch as we were instructed to eliminate the waiver class, our cases resolved themselves into the accepted

TABLE OF 656 REFERRED CASES FROM 23 943 DRAFT MEN

	Number	Per cent.	Accept.	Per cent.	Reject.	Per cent.
Myocarditis	9	0.036	0	0.00	9	100.0
Mitral stenosis	17	0.071	0	0.00	17	100.0
Mitral insufficiency	69	0.28	10	14.4	59	85.5
Aortic stenosis	9	0.036	1	11.1	8	88.8
Aortic insufficiency	19	0.079	0	0.00	19	100.0
Congenital lesions	2	0.008	1	50.00	1	50.0
Bradycardia	1	0.004	1	100.0	0	00.0
Tachycardia, simple	182	0.76	97	53.3	95	46.6
Sinus arrhythmia	4	0.016	4	100.0	0	00.0
Extrasystolic arrhythmia	37	0.11	33	89.0	4	10.9
Dilatation	1	0.004	0	0.00	1	100.0
Hypertrophy (without hyper- tension)	22	0.09	18	81.8	4	18.1
Hypertrophy (with hyperten- sion)	27	0.10	5	18.5	22	81.4
Functional cardiovascular dis- order	26	0.10	6	23.0	20	76.9
Pulmonary systolic	42	0.17	42	100.0	0	0.0
Apex systolic	66	0.27	66	100.0	0	0.0
Cardiorespiratory	32	0.13	32	100.0	0	0.0
Murmurs without significance	2	0.008	2	100.0	0	0.0
Hyperthyroidism	48	0.13	18	37.5	30	62.5
Arteriosclerosis	20	0.08	0	0.00	20	100.0
Aneurysm	2	0.008	0	0.00	2	100.0
Femoral	1					
Carotid	1					
Aortic syphilis	2	0.008	0	0.00	2	100.0
Arterial hypertension	3	0.012	0	0.00	3	100.0
Goiter (simple)	2	0.008	2	100.0	0	0.0
Normal heart	10	0.04	10	100.0	0	0.0
Reduplication (first mitral)	1	0.004	1	100.0	0	0.0
Reduplication (second pul- monic)	1	0.004	1	100.0	0	0.0

or rejected groups. The following diseases in our series were, without exception, rejected

Class A

1. Aortic insufficiency
2. Mitral stenosis.
3. Myocarditis.
4. Arteriosclerosis.
5. Cardiac dilatation.
6. Aneurysm.
7. Aortic syphilis.
8. Arterial hypertension.
9. Mitral insufficiency with hypertrophy, tachycardia, hypertension, and poor response to exercise

The following conditions were, without exception, accepted

Class B

- 1 Sinus arrhythmia
- 2 Pulmonary systolic murmur
- 3 Apex systolic murmur
- 4 Cardiorespiratory murmur
- 5 Mitral insufficiency without hypertrophy, tachycardia, hypertension, and with good response to exercise.

The following defects were in some instances rejected and in some instances accepted

Class C

- 1 Aortic stenosis
- 2 Congenital lesions
- 3 Tachycardia.
- 4 Extrasystolic arrhythmias
- 5 Hypertrophy without hypertension
- 6 Hypertrophy with hypertension
- 7 Functional cardiovascular disorder
- 8 Hyperthyroidism.
- 9 Simple goiter

Thus it will be seen that the average run of cardiovascular cases numbers not more than 25, of which 9 can be absolutely rejected, 5 unconditionally accepted, and but 9 which require any special study before their disposition can be determined. Records have been kept of the cases in Classes B and C, and these will be analyzed in this paper

I Analysis of accepted cases—Class B

1 Sinus arrhythmia Only 4 cases were seen exhibiting this alone. Other cases, it is true, had sinus arrhythmia, but they had symptoms or signs of a more prominent condition, under which they have been classified. We were impressed with the relative infrequency of this type of arrhythmia, termed by McKenzie "the youthful type." The men were between twenty-two and twenty-three years of age, and apart from syphilis and the history of pneumonia in one man, the previous medical history was negative. Two were without any complaints and two had dyspnea, palpitation, pain, and giddiness. One man

had a blood pressure of 152-98, while the others were normal. The exercise test was normal in all, but one reacted more slowly than the others, and this one had a cardiorespiratory murmur.

The condition is essentially benign, and although there is still some confusion about its recognition, it should never be confounded with the serious arrhythmias.

2 Pulmonary systolic murmur, 42 cases. This was a relatively frequent occurrence, the murmur being heard in the second, third, or fourth left interspaces, and sometimes as far as the fifth, but generally loudest in the second and third interspaces. The diseases which might have some etiologic bearing on the production of the murmur occurred as follows:

Syphilis	11	Immoderate smoking	4
Tonsillitis	9		
Pneumonia	8		
Rheumatism	5		

Few of the men were engaged in occupations which demanded heavy work, so this factor can have little to do with the etiology.

Most of the men had symptoms distributed as follows:

Palpitation	28
Giddiness	25
Pain	23
Dyspnea	21
Edema	6
Fainting	5

The blood pressure was somewhat elevated and also the pulse rate, but the response to exercise was universally good. The average blood pressure was 135-86.

Other phenomena associated were—

Apex systolic	1
Slight thyroid tumor and tremor	1
Slight hypertrophy	1
Tachycardia	1
Exophthalmos	1

In only one instance was the murmur better heard in the recumbent position

Does the frequent occurrence of syphilis have any bearing?

3 Apex systolic murmurs, 66 cases This murmur, in every sense benign, is of relatively frequent occurrence The incidence of diseases with some possible bearing was

Tonsillitis	19	
Pneumonia	12	
Rheumatism	10	
Syphilis	8	
Scarlet fever	2	
Chorea	1	Immoderate smoking 5

The symptoms occurred—

Palpitation	45
Dyspnea	32
Giddiness	28
Pain	25
Edema	5
Fainting	1

The average of pulse-rate was somewhat above normal, but in nearly every case with but very few exceptions the response to exercise was good The average blood-pressure was 131-8.

Other phenomena associated were—

Pallor	3
P ₂ accentuated	3
Tachycardia	4
Systolic thrill	2
Pulmonary systolic	2
Diffuse apex	2
Slight hypertrophy	1
Thyroid tumor and tremor	1

The frequent occurrence of tonsillitis in the previous history raises the question whether some of these apex systolic murmurs are really accidental or are caused by valve lesions Clinically one cannot say definitely, but our diagnosis has rested on the

quality of the murmur, the sharp localization of the murmur (no transmission), and the disappearance of the murmur when the individual is recumbent. It would be a practical and academic question not without bearing on the future work of the cardiovascular boards if these cases of supposedly benign systolic murmurs could be followed up and examined later to determine their physical condition after several months of army life.

4 Cardiorespiratory murmurs, 32 cases

Previous medical history

Tonsillitis	15		
Syphilis	5		
Rheumatism	4		
Pneumonia	3		
Chorea	1	Immoderate smokers	3

Symptoms

Palpitation	24
Dyspnea	13
Giddiness	9
Pain	7
Edema	5
Fainting	2

The average pressure was 127-79

Other phenomena associated

Accentuated aortic second	1
Accentuated pulmonary second	1
Cyanosis—exophthalmos	1

The cardiorespiratory murmurs were all systolic in time and were heard for the most part at the apex, though not infrequently at the angle of the left scapula. They are best heard during deep inspiration and expiration—being loudest in the middle of both and disappearing at the end of full inspiration and complete expiration. The only confusion that can possibly arise is the differentiation between it and cog-wheel breathing, but the latter can be eliminated by having the man hold his breath in mid inspiration, when the murmur will persist.

Tonsillitis here, as well as in the apex systolic murmurs, was encountered rather frequently

5 Mitral insufficiency without hypertrophy, tachycardia,

hypertension, and with good response to exercise Ten such cases occurred out of 69 cases of mitral insufficiency In some no etiologic factor could be determined

Previous medical history

Tonsillitis	4	
Rheumatism	3	
Chorea	1	
Pneumonia	1	
Syphilis	1	Immoderate smokers 2

Symptoms

Dyspnea	8
Palpitation	6
Giddiness	6
Pain	3
Fainting	3

None of these cases had hypertrophy, 4 had pressures above 135 mm Hg, and 2 had poor response to exercise. However, the 4 causes for rejection—namely, hypertrophy, tachycardia, poor response to exercise, and hypertension—were not present in any one individual The striking thing in these accepted cases was the absence of hypertrophy and the good response to exercise which distinguishes them from the rejected cases

The blood-pressure average was 128-80

Other phenomena

Pulmonary systolic	2
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II Analysis of cases—Class C

1 Aortic stenosis This disease is generally to be rejected, but in one instance we took the risk of accepting the man, as he was a good physical specimen, had no complaints, and had a good response to exercise

2 Congenital lesions When definitely proved, as far as clinical examinations can go, the condition is a cause for rejection according to the manual of instructions for medical advisory boards The case we accepted was diagnosed by us as patent ductus arteriosus Botalli, and showed absolutely no discomfort from his defect He had always been active, and examination,

as far as hypertrophy, pulse-rate, and exercise response, was negative. Adult cases of patent ductus generally are able to do hard work as well as normal cases, and it was my impression that there was very little risk in accepting this man.

3 Tachycardia This class of cases presents the greatest difficulty in deciding the question of disposition. There are so many factors which influence the pulse-rate that no hard-and-fast rules can be adopted. It must always be borne in mind that the recruit is not at his best on the first examination. Sometimes he is examined on the day of his arrival in camp, sometimes he has just had his large noonday meal, and sometimes he has not had any dinner. Under any condition the recruit on his arrival is very nervous, he is living under conditions entirely foreign to his previous life, and the ordeal of passing through the hands of successive examiners reacts on his cardiovascular system to a disconcerting extent.

For the most part our men have been already examined by the tuberculosis board and have been put through breathing tests which increase their heart rate, but at the same time are directly to the advantage of the cardiovascular board, as tuberculosis is immediately eliminated as a cause for the tachycardia. Some of these men do not react well to the exercise test if the criterion is the pulse-rate after resting two minutes. When a good physical specimen fails to exhibit a pulse-rate below or the same as that shown in the pre-exercise period, he is put aside, and told to lie quietly for a time. Very often at the end of five or ten minutes the pulse-rate becomes normal, not infrequently we examine at the end of fifteen or twenty minutes.

The previous medical history of our accepted cases of tachycardia is as follows

Tonsillitis	32
Pneumonia	19
Rheumatism	17
Syphilis	10
Diphtheria	4
Chorea.	2
Scarlet fever	1

Immoderate smoking was found in 7 men, excessive use of alcohol in 4.

Symptoms occurred as follows

Palpitation	64
Dyspnea	59
Pain	54
Giddiness	49
Fainting	19
Edema	14

The average pulse rate was 123, and blood pressure was 134-90

When a definite cause for the tachycardia was supposedly found, it was due to—

Tobacco	17 times
Nervousness	12 "
Alcohol	5 "
Hookworm	1 time
Fever	1 "
Asthma	1 "
Recent illness	1 "
Dysentery	1 "
Malaria	1 "
Syphilis	1 "
Fibrosis	1 "
Active tuberculosis	1 "
Medication	1 " (taken to avoid acceptance, probably atropin)

Other phenomena associated with the tachycardia were

Tremor	5
Sinus arrhythmia	4
Apex systolic	2
Extrasystoles	2
Pulmonary systolic	2
Pallor	2
Dyspnea	1
Cyanosis	1

4 Extrasystolic arrhythmias Contrary to the general impression, there were more extrasystolic arrhythmias than sinus arrhythmias, leading one to the conviction that it is not an arrhythmia peculiar to old age alone, but is a rather frequent occurrence in men under thirty years of age. It was met with in 37 cases, 33 of whom were accepted for military service. The extrasystolic arrhythmia in all the accepted cases disappeared after exercise (hopping on one foot 100 times). When it did not disappear, but became more pronounced and was associated with poor exercise response, the cases were rejected.

Previous medical history

Tonsillitis	9		
Pneumonia	6		
Syphilis	5		
Rheumatism	3	Immoderate tobacco	8

Symptomatology

Palpitation	18
Dyspnea	15
Pain	10
Giddiness	10
Edema	3

The average pulse-rate was 96 and the average blood pressure was 138-86.

Other phenomena

Apex systolic	2
Pulmonary systolic	1

The ratio of extrasystoles to the pulse rate was once every 4 beats in the majority of cases.

5 Hypertrophy without hypertension The majority of these cases were accepted (18 out of 22), the rejected cases showing poor response to exercise

Previous history

Pneumonia	7		
Tonsillitis	5		
Syphilis	2	Immoderate smoking	5

Symptomatology

Palpitation	10
Pain	9
Dyspnea	8
Giddiness	6
Fainting	3
Edema	3

Other phenomena

Apex systolic	1
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Average pulse rate before exercise 96, after exercise (two minutes), 87 Average blood-pressure 134-87

7 Functional cardiovascular disorder It is a difficult matter in recruits to decide between functional cardiovascular disorders or effort syndrome, on the one hand, as a diagnosis, or simple tachycardia on the other, and the line is by no means sharply drawn There is no doubt that we have included under tachycardias some functional cardiovascular disorders, but discrimination has been exercised as far as lay in our power

Previous history		
Tonsillitis	1	
Pneumonia	1	
Symptomatology		
Giddiness	5	
Dyspnea	4	
Palpitation	2	
Fainting	2	
Pain	1	
Edema	1	
Other phenomena		
Hookworm	2	
Slight thyroid tumor	1	
Slight edema	1	
Average pulse-rate 118, after exercise (two minutes), 103 Blood-pressure 127-92		

8 Hyperthyroidism (9 of the 18 cases were from Ohio and Illinois)

Previous history			
Tonsillitis	4		
Rheumatism	3		
Pneumonia	2	Immoderate tobacco	4
Symptomatology			
Palpitation	7		
Dyspnea	3		
Pain	2		
Giddiness	2		
Edema	2		
Associated signs of thyroid involvement			
Tumor	14		
Exophthalmos	8		
Tremor	6		
Diarrhea	1		

Average pulse-rate 93, after exercise (two minutes), 94 Blood pressure 134-77

The rejected cases were differentiated from the accepted cases by the presence of marked thyroid enlargement, marked hypertrophy and marked tachycardia, and poor response to exercise

Very few of the accepted cases showed hypertrophy to any extent

9 Simple goiter When the thyroid enlargement is not disfiguring and is not associated with any marked signs of hyperthyroidism, they should be accepted

MENINGOCOCCIC PERICARDITIS, WITH REPORT OF 12 CASES MEDICAL SERVICE OF THE BASE HOS- PITAL, CAMP JACKSON, S C

BY MAJOR W W HERRICK, M C, U S A.

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For a satisfactory understanding of the complications of epidemic cerebrospinal meningitis a proper knowledge of the fundamental nature of the disease is necessary. Such knowledge has undergone considerable change within the past year. This change is the result of a study of the disease under the unwonted conditions of military life.

The result of the study of epidemic cerebrospinal meningitis in the camps has been the quite definite establishment of the disease as primarily a meningococcic sepsis, a blood-stream invasion from the initial focus in the upper air-passages with usual but not constant localization in various susceptible parts of the body (1), (2), (3). The most common site of secondary localization is, of course, the meninges. In our experience this meningeal localization has followed the general meningococcic sepsis in 96 per cent. of the cases, next in frequency the lung, the joints, the eye, the serous membranes, the testicle and epididymis, and the endocardium are involved.

In an epidemic of 280 cases observed at the Base Hospital, Camp Jackson, South Carolina, there were 12 examples of pericarditis. These present many points of clinical and pathologic interest. Brief case reports follow.

CASE 1.—Tilley. Serial No 3643, was admitted to the Base Hospital December 20, 1917, giving history of a chill on the previous day, with nausea, repeated vomiting, and a feeling of general soreness. On admission he complained of frontal headache and that he was "sore all over." His temperature was 99.2° F.,

the pulse, 84. He presented the symptoms and signs of a mild epidemic cerebrospinal meningitis. The spinal fluid contained meningococci. He ran a typical course of a mild case of epi-

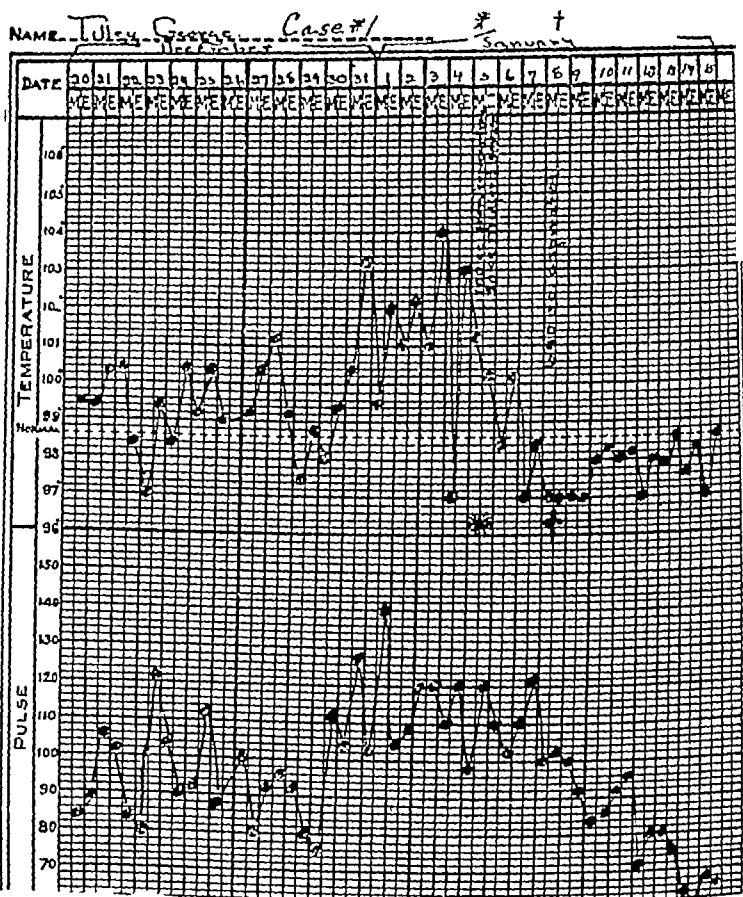


Fig 80—Temperature record in a case of meningococcic pericarditis with large effusion. *, 125 c.c. aspirated from pericardium, 30 c.c. antimeningococcus serum injected. †, 640 c.c. aspirated from the pericardium

demio meningitis except that an irregular temperature persisted during convalescence and increased to 104° F on January 3d. On January 5th there were signs of a considerable pericardial effusion. There was dyspnea and slight cyanosis. The right

border of the heart was 2 inches from the right edge of the sternum, the left border $1\frac{1}{2}$ inches beyond the left nipple. The sounds were muffled and indistinct. There were no frictions. Aspiration in the fourth right interspace about 1 inch from the sternum gave bloody purulent fluid which on smear and culture showed meningococci, 125 c.c. of fluid was removed, 30 c.c. of antimeningococcus serum was introduced into the pericardium without discomfort or reaction. On the following day the temperature fell to 101.2° F. On the 6th it fell to normal and remained so. The pulse-rate more gradually returned to normal.

Five days after the first aspiration there were signs of returning pericardial effusion. Aspiration by Captain E. W. Barron, M. C., gave 640 c.c. of purulent fluid containing large numbers of fibrin flakes. No micro-organisms were found either on microscopic examination or on culture (Fig 80).

Convalescence was prolonged because of tachycardia and dyspnea upon effort. After treatment in the cardiac ward by rest and suitable graduated exercises the patient made a complete recovery and returned to full duty. There was no evidence of pericardial adhesion. The heart retained a normal amount of mobility, was not increased in size, and on careful fluoroscopic and roentgenographic study showed no evidence of adhesions to the diaphragm or other structures.

CASE 2—Stevenson. Serial No 5460. Colored Civilian, sixteen years old. This patient was admitted to the Base Hospital January 22, 1918. He was unable to give any intelligent answers to questions because of the stuporous condition, but presented the clinical picture of a severe cerebrospinal meningitis which was confirmed by lumbar puncture when meningococci were demonstrated. There was paralysis of the right face and divergent strabismus. A pericardial friction developed on January 25th. The patient responded to treatment and made a complete recovery, being discharged to duty March 1, 1918, without any evidence of permanent cardiac or other damage.

CASE 3—Robinson. Serial No 3190, was admitted to the Base Hospital on December 27, 1917. On the morning of December 26th he felt nauseated and later in the day had severe

frontal headache. He remained in quarters. On the following day he was brought to the Base Hospital as a case of meningitis. On arrival he was stuporous and could give no definite history. The pharynx was congested, petechiæ were found over the extremities, the neck was rigid, and Kernig's sign positive. On admission the temperature was normal, the pulse-rate 126. The spinal fluid was cloudy and contained meningococci. A total of 365 c c of antimeningococcus serum was injected into the spine and 170 c c into the vein. He showed as a complication a right epididymitis and orchitis. There was moderate temperature, with 101° F as a maximum, and a rather rapid irregular pulse, gradually developing the symptoms and signs of blocking of foramina with hydrocephalus. On January 7th he developed a loud to-and-fro pericardial friction and had the signs of a patchy consolidation over the bases of the lower lobes. On January 9th arthritis of the right shoulder appeared, also a moderate torticollis. The signs of small areas of consolidation of the lung remained. Pericardial frictions were present and arthritis of the right knee. On February 3d the right knee-joint was aspirated and 42 c c of cloudy fluid containing meningococci removed, 15 c c of Lederle antimeningococcus serum were injected into the joint. The patient continued to decline in strength, the mind became clouded, and emaciation increased. February 10th, while being examined, the patient suddenly became cyanotic and ceased breathing. Lumbar puncture was performed and about 12 c c of orange-colored fluid was removed, not under pressure. Voluntary respiration did not return and life was maintained by artificial respiration. Cervical puncture was made in the midline at a level of the tips of the mastoid processes or between the atlas and occipital bone, the needle passing upward into the posterior segment of the foramen magnum. Fluid shot out under marked pressure. At first it was clear, later turbid and blood tinged. About 100 c c were removed. At this time voluntary respirations were resumed apparently as a direct result of the reduction of intracranial pressure. Later another cervical puncture was performed at the same site as before and 15 c c of bloody

fluid withdrawn The patient's condition became more serious and death followed At necropsy the body was thin, emaciated, the cheeks sunken The thoracic cavity showed the remains of the thymus gland There were a few adhesions at the apex and base of the left lung with bronchopneumonia of the upper lobe of the right lung The heart showed general fibrinous pericarditis and rather large shaggy masses of partly organized fibrinopurulent exudate The endocardium was not examined The spleen was slightly enlarged and congested The liver, of normal size, was slightly pale in color The pancreas was normal The kidneys were normal in size, with slight cloudy swelling and moderate congestion Brain The inferior surfaces of the cerebellar hemispheres were pyramidal in shape and surrounded by a ring of depression from forcible contact with the margins of the foramen magnum, into which the pointed pyramids protruded A continuous blood-clot, firmly attached to the lower surface of the right cerebellar hemisphere, extended through the fourth ventricle, the aqueduct of Sylvius, and into the third ventricle. This clot was dark and firm No free blood was present in the ventricles or beneath the cerebellum The lateral ventricles were greatly dilated in all directions, including the horns. The dura mater was thin, pink, and not adherent. The blood vessels of the pia mater were prominently distended over the cerebral and cerebellar hemispheres The convolutions of the cerebral hemispheres were flattened and the sulci greatly lessened in depth There was no purulent exudate.

Diagnosis —1, Acute hydrocephalus, 2, recent hemorrhage from the inferior surface of the right cerebellar hemisphere into the fourth ventricle, iter, and third ventricle, 3, cerebellar plugging of the foramen magnum or cerebellar hernia, 4, right upper lobe bronchopneumonia, 5, subacute adherent pericarditis, 6, subacute pleural adhesions

CASE 4 —Cockerhan. Serial No 4196, was admitted to the Base Hospital January 14, 1918, giving a history of four days of general aches and pains. The temperature on admission was 100° F He showed all the evidences of a ~~rather~~ well advanced

epidemic cerebrospinal meningitis, with cloudy spinal fluid containing meningococci. On January 15th severe arthritis of the right knee and both wrists developed, with milder symptoms in other joints. There was a marked hemorrhagic rash and a rapidly developing left panophthalmitis. On January 21st he developed signs at the angle of the left scapula suggesting consolidation. The temperature rose to 102° F, the pulse to 162. He died on January 24th. He was given a total of 315 c.c. of antimeningococcus serum intraspinally and 125 c.c. intravenously.

Necropsy —The body was that of a well-nourished male with left panophthalmitis. Both lungs were crepitant throughout, but showed passive congestion and hypostatic pneumonia. Heart. The pericardial sac was filled with a thick, well-organized, shaggy, fibrinopurulent exudate firmly attached to the visceral as well as the parietal pericardium, and covering the entire heart. The masses of exudate were astonishingly large, some being as much as 2 inches thick. The exudate was of a light yellow tint and very dense. The picture was that of a "shaggy" or "bread-and-butter heart" of an exaggerated degree. The pericardium contained no free fluid. The spleen and the liver showed passive congestion, the kidneys, acute cloudy swelling. Brain. There was a purulent exudate on the vertex along the longitudinal sinus. The cortex was hyperemic. Upon opening the duodenum an acute hemorrhagic duodenitis was seen.

Diagnosis —1, Epidemic cerebrospinal meningitis, 2, shaggy fibrinopurulent pericarditis, 3, acute hemorrhagic duodenitis, 4, parenchymatous nephritis.

CASE 5 —White. Serial No 4166. This patient was admitted to the Base Hospital January 1, 1918. On the previous day he had a chill followed by fever. He complained of pain in the small of the back and frontal headache on the morning of January 1st. He remained in bed prostrated, and later in the day was sent to the Base Hospital. On admission his temperature was 100.2° F. The spinal fluid was cloudy and showed meningococci. The patient ran the course of a moderately severe epidemic cerebrospinal meningitis. On January 15th

there was the development of facial erysipelas, with a faint friction-sound over the precordium. On January 19th the patient became stuporous and died

At autopsy the body was emaciated, showed thickened skin on the left side of the face, with some vesiculation. The appendix and gall bladder were bound down by adhesions. The liver was adherent to the diaphragm by an adventitious membrane. The spleen was soft and mushy. The liver was soft, with large areas of cloudy swelling and beginning fatty change. The kidneys showed cloudy swelling and early fatty degeneration. Heart. There was no excess of pericardial fluid. On the outer surface of the left ventricle near the apex there was a patch of organized purulent exudate about 2 cm. in diameter. Lungs. The right showed firm pleural adhesions from the upper and lower lobes to the lateral chest wall. In the left lung there were firm organized adhesions with a few patches of bronchopneumonia in the upper and lower lobes and hypostatic congestion in the lower lobe posteriorly. Brain. There was a large amount of coagulated purulent exudate closing the foramen magnum. Over the superior surface of the cerebellar hemispheres and vermis there was well-organized exudate of the same nature. The brain tissues were exceedingly soft. There was purulent exudate over the cortex of the parietal regions, the convolutions were flattened, the sulci shallow. The veins of the pia were deeply turgescient and large. The cortex was hyperemic. The lateral ventricles were distended, containing thick, creamy yellow purulent exudate, covering the choroid plexus of each lateral ventricle. The foramina of Munro had a strand of purulent exudate of the same character extending through each foramen. The third ventricle was filled with the same sort of exudate. The right sphenoidal sinus contained pus of a like description.

Diagnosis—1, Epidemic cerebrospinal meningitis, 2, chronic adhesive pleuritis, 3, fibrinopurulent pericarditis, 4, epidemic cerebrospinal meningitis of the base, 5, bronchopneumonia, left lung, 6, erysipelas, facial, 7, sphenoidal sinusitis, purulent.

CASE 6—Denson. Serial No 3211. This patient was ad-

mitted to the Base Hospital December 6, 1917, in an unconscious condition. There was projectile vomiting, a petechial rash, Kernig's sign, stiff neck, and an extremely weak and rapid heart. The condition was one of collapse. There was general cyanosis. The lungs showed moisture at both bases, with many subcrepitant râles. There was a rapidly developing panophthalmitis of the right eye. The temperature was normal, the respiration 38, and the pulse imperceptible. The spinal fluid was cloudy and showed meningococci. A total of 110 c.c. of antimeningococcus serum was injected intraspinally. The condition rapidly became more grave, bilateral choroiditis appeared, and on December 10th the patient died. No signs of pericarditis were detected during life.

Necropsy—The body was emaciated and was dotted with a marked general petechial rash. Eyes Suppurative choroiditis. Brain The dura was markedly congested, as was the pia, and was adherent in spots to the cortex of the anterior lobe. Gray purulent fluid was present over the entire surface of the cortex. Both hemispheres were congested. The lungs showed passive congestion. The pericardium was distended by about 600 c.c. of yellow purulent fluid containing flakes of fibrin. Heart Enlarged, the right auricle being markedly distended with clotted blood. The surface of the heart was covered with a fibrinous coat. The valves were normal. The liver was congested, though normal in appearance, the gall-bladder was distended with bile. The kidneys showed passive congestion. The peritoneum was actively congested from early peritonitis.

The *anatomic diagnosis* was as follows 1, Epidemic cerebrospinal meningitis, 2, suppurative choroiditis, 3, acute fibrinous pericarditis, 4, acute peritonitis.

CASE 7—Pope Serial No 2909 This patient was admitted to the Base Hospital on December 1, 1917, giving a history of a sudden onset November 30th of chill, fever, severe headache, and repeated vomiting. The next morning the patient was brought to the Base Hospital as a case of meningitis. The temperature on admission was 96° F. On December 2d there were numerous petechial spots, a stiff neck, positive Ker-

ing's sign, and unequal knee-jerks. The spinal fluid showed meningococci. The temperature was moderate, the maximum being 103° F. The course of the fever was very irregular. Left panophthalmitis developed, with complete loss of vision in that eye. Death occurred December 22, 1917.

Necropsy—The body was thin and emaciated. Brain The dura was markedly congested, as was the arachnoid. The cortex was bathed in purulent gray fluid. Clots of yellow pus were present around the surface of the brain. The ventricles were filled with fluid, the foramina clogged with purulent fluid. Heart The parietal and visceral pericardium are adherent by recent fibrinous exudate.

Diagnosis—1, Epidemic cerebrospinal meningitis, 2, hydrocephalus from blocking of foramina, 3, pericarditis.

CASE 8—Pack. Serial No 3191. This patient was admitted to the Base Hospital on December 17, 1917, with a diagnosis of measles. He showed photophobia, headache, and general soreness of the body. On December 22d a diagnosis of epidemic cerebrospinal meningitis was made because of the stuporous condition, the frontal headache, the petechial rash, and unequal exaggerated reflexes. Bronchopneumonia developed very rapidly and proved to be a terminal event, death occurring December 28th. Meningococci were found in the spinal fluid and intraspinal treatment was given. No evidence of pericarditis was discovered during life.

Necropsy—The body was thin and emaciated. A petechial rash was present about the face and neck and a diffuse purpura covered the back. Brain The dura and arachnoid were markedly congested. The brain surface was congested and bathed in a thin gray purulent fluid. Thin gray fluid containing fibrin clots was found in both lateral ventricles. Lungs The right base was adherent to the pleura. There was lobular pneumonia of the right lower lobe. The base of the left lung was adherent over the entire lower lobe. Heart The pericardium was filled with about 100 c.c. of yellow cloudy fluid and flakes of fibrin. The heart was normal. The liver, spleen, and kidneys were enlarged and showed passive congestion.

Diagnosis—1, Fibrinous pleurisy, 2, fibrinopurulent pericarditis, 3, lobular pneumonia, 4, epidemic cerebrospinal meningitis

CASE 9—Buchanan Serial No 4801 This patient was admitted to the Base Hospital on January 12, 1918 The illness began suddenly on that day, with general malaise and headache, sore throat, and pains "all over" The temperature was 104.2° F, the pulse, 120 On January 13th he was transferred to the meningitis ward markedly prostrated There was a profuse purpuric rash over almost the entire body The neck was moderately stiff and Kernig's sign was present The spinal fluid was cloudy and showed meningococci He received a moderate amount of serum intravenously and seemed to make some improvement Left panophthalmitis developed on December 14th On the 15th he became restless, petechial rash and purpuric blotches appeared on the thighs, Kernig's sign was positive and subcrepitant râles were found at both bases The patient died on the same date

At *necropsy* the body was well nourished and well developed Many petechial spots and a hemorrhagic purpura with conjunctival hemorrhages were present There was hypostatic congestion of the lungs The heart was negative, but the pericardial sac contained fibrinopurulent fluid on both visceral and parietal surfaces Brain There was thin purulent fluid in the subarachnoid space on each side of the median longitudinal sinuses, also on the median surface of the cerebral hemispheres, the superior surface of the cerebellum, especially over the median part There was no purulent fluid in the ventricles The choroid plexus of each lateral ventricle was congested and showed several small cysts

Diagnosis—1, Epidemic cerebrospinal meningitis, 2, fibrinopurulent pericarditis

CASE 10—Romaquera Serial No 3604 This patient was admitted to the Base Hospital December 19, 1917, unconscious and in very poor condition The body was dotted with petechiæ There was congestion of the bases of both lungs, rigidity of the neck, and spastic paresis of the left arm and left

leg The temperature on admission was 102.4° F and remained elevated until his death, December 24th. During the latter part of the illness there was partial paralysis of the left side of the face and the left arm. Intraspinal and intravenous treatment was given. The spinal fluid was positive for meningococci. No signs of pericarditis were detected during life.

At *autopsy* the body was thin and emaciated. The skin was covered with a purplish brown hemorrhagic rash. Brain The dura was congested and distended. The arachnoid vessels were numerous and congested. The cortex showed a small amount of thin yellow fluid over the vertex, especially along the fissure of Rolando—more on the right than on the left. The convolutions were flattened, but soft. There was no pus or excess of fluid in the ventricles and no exudate over the base of the brain. Heart The parietal pericardium was covered by a thick yellow fibrinopurulent exudate. About 40 c.c. of pus were found in the pericardial sac. Lungs The lower lobes showed marked hypostatic congestion.

Diagnosis—1, Epidemic cerebrospinal meningitis, 2, purulent pericarditis, 3, hypostatic congestion of the lungs.

CASE 11—McLeod Civilian carpenter, forty years of age. This patient was admitted to the Base Hospital on May 27, 1918, with a temperature of 97.6° F and a pulse-rate of 94. He was cyanotic and thickly dotted with petechial spots and larger purpuric areas. He was apathetic, his head was not retracted, but the neck was stiff. Kernig's sign was positive. The heart and lungs were negative. The patient was stuporous and drowsy. He received vigorous intraspinal and intravenous treatment. On May 29th he was semicomatose and showed weakness of the left external rectus. The lungs were congested at the bases. There was an acute polyarthritis, involving wrists, ankles, and knees. The temperature rose to 104° F at death on May 29th. The spinal fluid and blood-culture were positive for meningococci.

At *necropsy* the body was that of a well-developed man with marked postmortem lividity. Over both feet and hands were subcutaneous hemorrhages, some $\frac{3}{4}$ inch in diameter. Brain

There was moderate bulging of the dura, with engorgement and lymphoid deposit along the sulci. Between the cerebellum and cerebrum there were numerous fibrinous adhesions. At the extreme base were several small masses of yellowish pus with marked congestion. The congestion of the choroid plexus was also extreme, but there was no excess of fluid in the lateral ventricles. Numerous petechial hemorrhages were found along the walls of the lateral ventricles. The brain was slightly softer than normal. Lymph-nodes. There was moderate congestion and softening of the tracheobronchial nodes. Pleural cavities. The left pleural cavity was completely obliterated by marked fibrous adhesions. The right pleural cavity showed fibrous adhesive pleuritis. There was moderate fatty change in the aorta. The pericardial sac contained 50 c.c. of yellow creamy pus. The visceral pericardium was roughened by tags of fibrin very loosely attached and showed numerous petechial hemorrhages. Heart. Posteriorly there was marked engorgement of the vessels of the heart. The valves were normal. The myocardium was rather soft and dark in color. Spleen. Moderate enlargement and softening. Liver. Moderate fatty change. Stomach. Contains a large amount of watery material. Lungs. Right pleural surfaces smooth and glistening except for the posterior and lateral surfaces, which are covered with fibrinous tags. The lung is crepitant throughout. On section the tissue was found normal in appearance except for marked hyperemia. The left pleural surfaces were torn throughout and markedly congested.

Diagnosis —1, Epidemic cerebrospinal meningitis, 2, fibrino-purulent pericarditis, 3, bilateral pulmonary hyperemia, 4, right posterior and lateral fibrinous pleuritis, left complete obliterating fibrous adhesive pleuritis, 5, marked gaseous distention of the bowels, 6, early fatty degeneration of the liver, 7, enlargement and softening of the spleen.

CASE 12 —Chestnut. Serial No 18,397. This patient was admitted to the Base Hospital on June 27, 1918, suffering from nausea, vomiting, headache, and coryza. The temperature was normal. Measles developed, which ran a normal course until

July 5th, when there was chill and rise in temperature to 102° F. The patient became semicomatose, a petechial rash appeared, and there was stiffness of the neck. The pulse was feeble. The apex of the heart was in the nipple line, the rate 140, regular, and with a marked gallop rhythm and some pulse deficit. The spinal fluid was removed under pressure, but was clear, showed no pus-cells, no organisms, and only a faint trace of globulin. It later became cloudy, but never showed meningococci. The blood-culture of July 6th was positive for meningococci. The patient gradually developed hyperpyrexia, cyanosis, and later collapse. A very profuse hemorrhagic rash appeared and the patient died July 9, 1918.

At *necropsy* the body showed numerous purpuric spots on the trunk and extremities. Brain. The surfaces were deeply congested, but there was no evidence of meningitis. The choroid plexus was very markedly congested and there was much bloody fluid in each lateral ventricle. The serous membranes showed small petechial spots on both visceral and parietal surfaces. Kidneys. Moderate cloudy swelling. The spleen was large and soft. Lungs. Each pleural cavity contained 650 c.c. of amber colored fluid. The pericardial sac contained 30 c.c. of cloudy yellow fluid containing fibrin and pus. There were numerous petechial spots over the pericardial surface. There was complete consolidation of the right upper and lower lobes, also of the left lower lobe. The heart was quite flabby, but there was no abnormality of the endocardium or valves. The muscle was pale and cloudy.

Anatomic Diagnosis—1, Acute fibrinopurulent pericarditis, 2, acute diffuse nephritis, 3, bilateral hydrothorax, 4, cloudy swelling of the parenchymatous organs, 5, acute splenic tumor, 6, purpuric skin eruption, 7, confluent pseudolobar bronchopneumonia, 8, epidemic cerebrospinal meningitis.

SUMMARY

Frequency—In an epidemic of 280 cases there were 12 examples of pericarditis, a percentage of 4.29.

Types of Cases in which Pericarditis Appears—Pericarditis

is a complication of serious meningococcic sepsis. With but one exception the 12 cases of this series were extremely serious. Only one was mild. In an epidemic, the mortality of which was 24.8 per cent, the mortality in cases showing this complication was 83½ per cent. In other words, 10 of the 12 cases with pericarditis died.

Pathology—Two types of meningococcic pericarditis may be described—the wet and the dry. Of the 12 cases here reported, there were 6 of each type. The amount of exudate was large in 2 cases, small in 4. The largest effusion amounted to 640 c.c., the next to 600 c.c., the rest to 100 c.c., 50 c.c., 40 c.c., 30 c.c., in order. The exudate was either a bloody, purulent, rather thin fluid containing small or large flakes or masses of fibrin, or a thick creamy yellow mixture of pus and fibrin. The large effusions were of the first-named type. Meningococci were present in most of these fluids. The exudate in the dry variety was fibrinopurulent in character, fibrin predominating. The fibrin varied in amount from a plaque 1 inch in diameter to the most exaggerated kind of “shaggy” or “bread-and-butter” heart. In one case the masses of fibrin were of almost inconceivable size, so that when retracted the pericardium in both visceral and parietal layers was covered by masses of shaggy yellowish-white exudate, some as much as 2 inches in diameter. The exudate in this case was much more massive than one ever sees it in cases of pneumococcic pericarditis.

Symptoms of meningococcic pericarditis are rarely as characteristic as those of the pericarditis of pneumococcic infections. Meningococcic pericarditis is merely a part of a severe systemic infection, its symptoms merge with those of the generalized disease. As a rule, these symptoms are high fever, a more rapid pulse, and a general increase in the toxemia. With the presence of a large effusion the expected symptoms and signs of this physical condition appear, and are not in any way peculiar. The pulse-rate in the series reported during the period of pericarditis averaged 124, varying from 84, the lowest, to 162, the highest, 10 of the 12 cases had petechiæ, 4 had positive blood-culture, 7 of the 12 cases had other severe meningococcic com-

plications—panophthalmitis, purulent arthritis, peritonitis, bronchopneumonia, paralysis, or hydrocephalus. But 4 of the 12 cases were discovered during life, 8 were discovered only at necropsy. The time of occurrence of the pericarditis of epidemic meningitis is important. One case developed one week after onset, another, three weeks, the remainder between these extremes. The cases showing dry pericarditis developed earlier than those with the large thin sanguinopurulent effusions, which occurred later in the course of the illness. In general it may be said that pericarditis is a feature of the late period of the acute stages of the disease. The effect on the heart of those cases that recover is important. Of the two cases making recovery, one was of the dry type, the other had a large effusion. The former made a prompt recovery without subsequent cardiac embarrassment, the second recovered only after a prolonged period of convalescence in which there was dyspnea and other evidences of moderate cardiac insufficiency. The final result, however, was excellent and the return to health apparently complete. Of interest in this case was the lack of proof of the existence of adhesions.

Diagnosis in this as in most conditions depends upon keeping the possibility in mind. Every case of severe meningococcic sepsis should be regarded as a potential pericarditis. The heart outline should be carefully noted so soon as a patient comes under observation and subsequent changes in shape or size noted. Appearance of a friction over the precordium should immediately make one alive to the condition, so also should much acceleration of the pulse-rate, dyspnea, increase in the size of the veins of the neck, cyanosis, or other well known evidences of pericarditis. With any increase in the severity of general toxemia one should be alert. With evidence of accumulation of fluid, exploratory puncture should be made in the usual way. A possible source of error in puncture is the plugging of the needle from the flakes of fibrin which are so commonly seen in the meningococcic exudate. One should be prepared for the injection of serum when the exploratory puncture is made.

Treatment—Of primary importance is the treatment of the general disease. Since pericarditis occurs in those cases in which meningococcic sepsis is present, the intravenous serum treatment is our mainstay. This should be carried out according to the method suggested in previous communications (1), (2), (3). In brief, this is the administration by vein of antimeningococcic serum in doses of 100 to 150 c c every eight to twelve hours until the symptoms are under control. The local injection of serum is most important. In one case with effusion the pericardial sac was promptly sterilized and all the general symptoms—fever, dyspnea, etc.—promptly disappeared after a single injection of 30 c c of antimeningococcus serum. This case was a remarkable example of the persistence of a single focus of meningococcic infection continuing to act as a source of general disturbance after other signs and symptoms had subsided, and emphasized the importance of search for such foci in eye, joints, ear, epididymis, lung, pleura, or elsewhere in those cases not making satisfactory progress. The satisfactory effect of local serum therapy is also emphasized. Other general measures, as morphin and external applications, need but passing mention. The question of introducing serum into the pericardial sac in which there is presumably only the dry type of pericarditis present is debatable. It must be governed by the circumstances of each individual case. It is probable that serum so introduced would have good effect. The technical difficulties are, however, obvious.

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PAROXYSMAL TACHYCARDIA IN SOLDIERS, WITH REPORT OF CLINICAL AND POLYGRAPHIC STUDIES

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Of the total number of 13,000 cases in the Base Hospital at Camp Zachary Taylor before May 1, 1918, there were 120 discharged with cardiovascular diagnoses. In these cases no attack of paroxysmal tachycardia was recorded or observed during their sojourn in the hospital. Since then, during my association with the institution, I had the opportunity to study a series of cases both clinically and by means of the Mackenzie polygraph. Unfortunately, no electrocardiograph was available to assist in the analysis of the cardiac phenomena.

I desire to place 4 cases of paroxysmal tachycardia and 1 paroxysm of auricular flutter on record because they present the typical clinical pictures of this form of tachycardia and bring out clearly its military aspect as it is encountered in our camps.

Among the characteristic features of the disease are sudden onset of an attack, with marked increase in the rate of the heart's action and its sudden cessation after a variable length of time, with a marked fall in rate. The frequency and the severity of the attacks vary. Their cause, the effect of the attacks upon the size of the heart, and the rôle of the vagi in their control will be discussed later.

The pace-maker for the heart in these cases is located in an abnormal place in the cardiac musculature, and not at the sino-auricular node. The site of origin of the abnormal rhythm may be supraventricular, in the auricular wall or the junctional tissue, or in the ventricular musculature. In these cases the

rhythm is regular. Paroxysmal tachycardia with total arrhythmia is usually associated with fibrillation or standstill of the auricles. When the rhythm is regular the extrasystole, or premature contraction, is the unit out of a series of which an attack of paroxysmal tachycardia is comprised. The rate of auricular contraction varies from 150 to 300 per minute. There are cases in which it is not possible to state the nature of the attacks without electrocardiographic studies.

The pathology of the disease is as varied as its clinical varieties. In Falconer and Duncan's case the paroxysms originated in the junctional tissues. Postmortem an acute inflammatory lesion was discovered beneath the aortic valves, involving the middle third of the main stem of the a-v bundle. Of 3 cases reported by Butterfield and Hunt, microscopic changes were found in 2 in the region of the sino-auricular node and in the third in the interventricular septum. These findings corresponded to the sites of origin of the paroxysms as diagnosed from the electrocardiograms. Leukocytic infiltrations due to rheumatic fever or syphilis or in the acute infections may be a source of origin for the attacks.

Two types of paroxysm are presented in this paper. In the first 4 cases the rate is very much increased over the normal and the heart-beat is regular. In each of these the origin of the attacks is at an abnormal site in the auricular musculature. In the fifth case the attack is due to auricular flutter. Though apparently irregular and at times slow, a certain regularity becomes manifest on analysis of the tracings, and an extremely high auricular rate is discovered.

The importance of the graphic observations in studying these cases cannot be overestimated. The great value of testing the functional capacity of the circulation in these cases to determine their proper disposition from a military standpoint are subjects of essential interest and importance at the present time.

CASE I.—Attack of paroxysmal tachycardia lasting seventy-two hours, pulse-rate reached 246 per minute, high temperature, cardiac dilatation, good functional capacity in the intervals between attacks.

Private O O K., aged twenty three, arrived at Camp Zachary Taylor, Kentucky, on April 27th and pursued the usual drilling maneuvers without any discomfort

Past History—He was previously a railroad signaller, an occupation that entailed moderately heavy work. He had mumps, chicken pox, and measles as a child, but no other illnesses or operations, and gave a negative venereal history. His family history was negative and his habits were good

Previous History—Since he was sixteen years old the patient suffered from occasional attacks similar to the one to be described. He had perhaps five or six within seven years, but was entirely free from them for two years before admission. The attacks were not induced by exertion and presented no apparent cause. They lasted a variable length of time, from several hours to perhaps one or two days. The first paroxysm came on while playing snow-ball. After each attack, for a few days, the patient felt a soreness of the muscles and tissues of the precordium

Present Attack—An attack began suddenly at 4 45 P M of May 14th while playing ball. The effort was not unusual and there was no apparent reason for the sudden onset of palpitation. The patient had a sense of precordial pressure, fullness in the throat, and some shortness of breath. He lay down in the field to rest, but, as the dyspnea continued, he was admitted to the Base Hospital.

Physical Examination—On admission, the examination showed the patient in good general condition, with clear and rather alert mentality. There was no cyanosis, the respirations were a little over 20 a minute.

The pulse was too rapid to be counted digitally. It was 208 beats a minute. It was markedly unstable and fluctuating in pressure and volume, but it maintained a perfect rhythm. The blood and pulse-pressure were very low, the systolic pressure was 90 mm and the diastolic was 74 mm. of mercury by the vertical manometer reading. The systolic pressure fell during inspiration to 78 mm. of mercury and rose with expiration. This is well illustrated in the polygraphic tracings.

The heart showed no abnormalities besides the extreme tachycardia. The left border and apex percussed two finger breadths inside of the nipple line and 8 cm from the median line. The upper border was located at the upper border of the third rib and the apex was in the fourth space.

The lungs were clear. Liver dulness extended from the fifth rib to the costal margin and the edge was not palpable. The spleen was not enlarged.

Course—Polygraphic tracings were taken with the Mackenzie ink polygraph. They showed interesting curves, which are analyzed below.

Attempts were made to stop the paroxysm by vagus influence. Pressure on both eyeballs and on both vagi directly was attempted, but without effect. The hypersensitiveness of the patient made it difficult to carry out these measures satisfactorily. Fifteen minims of digalen had been given hypodermically, cold water was splashed upon the chest, the patient was given large pieces of ice to swallow, but these measures were of no avail. An ice-bag was therefore applied to the precordium and to the neck and tincture of digitalis was administered in doses of 15 minims every four hours.

On the following day the heart rate had increased to 216 beats a minute and an unusual feature developed. The mouth temperature rose during the day from 99.4° to 103° F, and ran the course shown in the accompanying chart (Fig 81), falling to normal at the end of the attack. The explanation for the fever is doubtful. Perhaps it resulted from the tachycardia as a central thermogenetic manifestation, but one cannot assert this with any assuredness. There could be found no other obvious reason for the high temperature.

The following day the pulse-rate was 235 a minute. The radial pulse showed plainly the fall of pulse volume with inspiration. Toward evening the breathing became periodic, somewhat of the Cheyne-Stokes character, but without restlessness or grunting.

At 4 00 P M of the next day, May 17th, the heart percussed enlarged over its original size. The left border was at the nipple-

line and 10 cm from the median line and the right border percussed at the right sternal border. The apex beat remained in the fourth space. The heart rate was higher than before, beating 246 times a minute. There was no cyanosis. The respirations had been between 28 and 32 times a minute throughout the paroxysm. The liver was not enlarged nor tender and there was no edema. The patient had received up to this time 165 minims of the U S P tincture of digitalis and 15 minims of digalen.

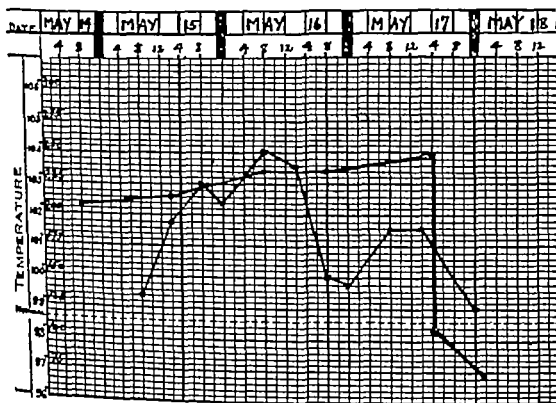


Fig. 81—Temperature curve and heart rate during the period of the paroxysm. Note the sudden change of rate from 246 per minute to 106 and then to 68 per minute.

At 5.30 P M., exactly one and a half hours after the last pulse tracings were made and just about seventy two hours after the onset of the attack, the patient was found to have a remarkable reduction in pulse-rate—100 a minute. He had slept a little while, but had felt no unusual or notable symptoms.

The heart now also showed a striking difference from the examination of an hour and a half before. The left border had

receded to its original position, two fingerbreadths inside of the nipple, line and the right border returned to the midsternal line. The respirations slowed and the patient felt quite well. There was no arrhythmia.

But after several hours a marked respiratory arrhythmia was evident. The average pulse-rate now was 68 a minute. The systolic blood-pressure rose during expiration to 134 mm and fell to 130 mm during inspiration, but the diastolic pressure remained unchanged. The systolic pressure was quite stable after the attack.

The blood-count, urinalysis, and Wassermann test were negative. No radiogram was taken of the patient's heart during the attack. Two days after the x-ray examination showed a normal heart shadow.

Tests of the functional capacity of the circulation were made one week after the cessation of the attack while the patient was convalescing. No delayed rise of blood-pressure occurred even after 6000 foot-pounds of work. Table I (p. 433) presents the findings compactly. The patient was found unfit for overseas duty and was recommended for domestic service.

Polygraphic Study—Polygraphic tracings were obtained with the Mackenzie ink polygraph four hours after the onset of the attack on May 14th. They showed the characteristic jugular curve of paroxysmal tachycardia. The site of origin of the abnormal rhythm was located probably in the auricular wall.

The phlebogram (Fig. 82) presents the ventricular form of curve with two well-marked waves: the larger *c* is due to ventricular systole and begins about midway up the ascending limb of the peak. The smaller wave is the *v*-wave. The auricular contraction is represented probably by the lower half of the *c*-rise. The *a-c* interval is less than one-tenth of a second. The undulating form of the radial curve is frequent in these cases. The cardiogram was of trapezoidal form, but otherwise showed nothing of note. The pulse-rate is 207 beats per minute. On May 15th the rate increased to 216 per minute (Fig. 83). The phlebogram is of the same character as before. The tracings taken from the apex of the heart, however, show a distinct

TABLE I

	S.	D.	S.	D.	S.	D.	S.	D.	S.	D.
Pulse-rate, seated	102		72		96		96		102	
Pulse-rate, standing	120		64		96		108		114	
Blood pressure, seated	95	65	112	54	100	66	104	75	93	60
Blood pressure, standing	106	68			15 S. 40		105	75	105	75
Exercise performed:	{ Hopping		20 S 30		5 feet		15 S 50		15 S 80	
	{ 100 times		2 feet		3000		5 feet		5 feet	
	{ 2000		1200				3750		6000	
Foot pounds of work	162						144		120	
Pulse-rate immediately after	145	70	108		135		123	60	135	55
Blood-pressure 30 seconds after	140	70	103	50	130		123	60	135	65
Blood-pressure 60 seconds after	128	65	94		120		115	65	128	65
Blood pressure 90 seconds after	120	70			120		108	70	120	70
Blood-pressure 120 seconds after	114						96		90	
Pulse-rate 2 minutes after										

¹ Hopping 100 times is the exercise prescribed by Circular 21 from the Office of the Surgeon General. The other tests were dumb-bell exercises performed according to the Barringer method. This patient weighed 135 pounds.

series of waves superimposed upon an irregularly trapezoidal form of curve

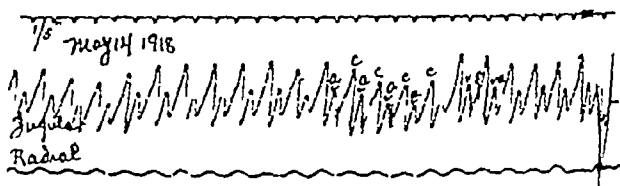


Fig 82—Simultaneous tracings of the jugular and radial pulses during attack of paroxysmal tachycardia. Note slight pulsus alternans in the radial tracing. The rate is about 208 a minute. In cases of paroxysmal tachycardia it is often very difficult to interpret satisfactorily the tracings obtained from the neck.

On the next day, May 16th, the pulse-rate was 235 a minute (Fig 84). The radial curve shows more clearly than before the

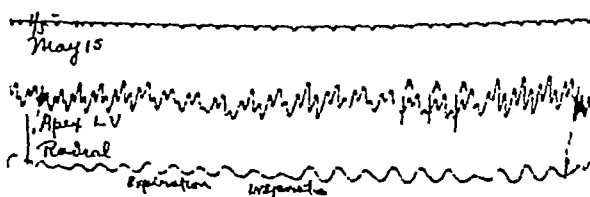


Fig 83—The cardiogram shows several waves, difficult of exact analysis. The rate is 216 a minute.

variation of blood-pressure and pulse-volume occasioned by inspiration and expiration. The fall of systolic blood-pressure occurs with inspiration.

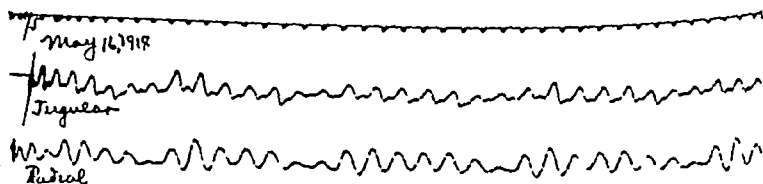


Fig 84—Simultaneous tracings of the jugular and radial pulses. Note the well-marked respiratory effect upon the height of the radial wave. With inspiration there is a fall of blood-pressure and flattening of the radial curve. The rate is 235 per minute.

On May 17th at 4 P. M. the heart-rate was higher than at any time before, beating 246 times a minute (Fig 85). At

5.30 P M, exactly one and a half hours after that, the pulse-rate was found to be 106 a minute (Fig 86) The phlebogram

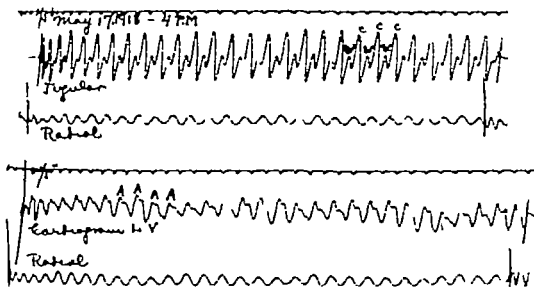


Fig. 85.—The rate has risen to 246 times per minute.

now shows the normal physiologic form, with normal *a-c-v* sequence. The heart apex curve is now triangular

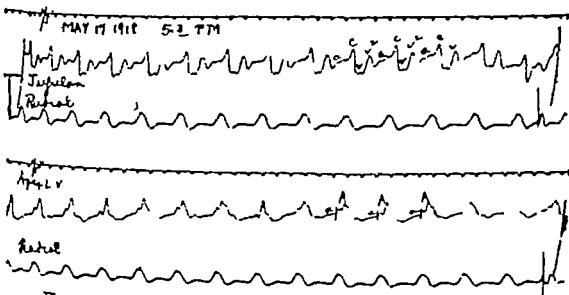


Fig. 86.—Simultaneous tracings of the jugular wave and cardiogram with the radial pulsation taken soon after the sudden cessation of the attack. Note also the change and variations in form of the cardiographic curve.

After several hours a marked respiratory arrhythmia became evident. In the tracing (Fig 87) the vagus slowing is shown plainly during inspiration. The average pulse-rate is now about 68 a minute.

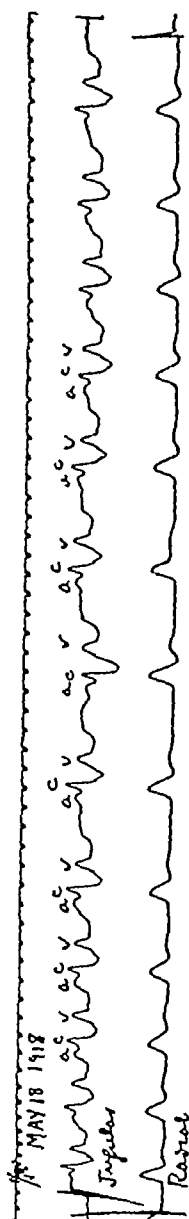


Fig 87 —Marked respiratory sinus arrhythmia. The effect upon the vagus is shown in the slowing during apnea. It is interesting that the vagus is influenced with such facility after the attack, and that it was so difficult to stimulate it during the attack.

Discussion.—From the point of view of the venous pulse alone, as has been shown by Peabody, all cases of paroxysmal tachycardia apparently fall into a group in which the venous pulse assumes the "ventricular" or "positive" type, and there is no evidence of any contraction of the auricles

CASE II.—Paroxysmal tachycardia with diminished functional capacity between attacks. K. E. S., aged twenty-four, a recently enlisted soldier, was in the Base Hospital since April 11th for observation for heart disease

Past History —He had been a farmer for several years, doing moderately heavy work. He had measles, chicken pox and mumps, and an attack of "grippe" some years before enlistment, no other illnesses nor operations. He gave a negative venereal history and had abstemious habits. His family history was negative.

Previous Attacks —For six years he had moderate but constant shortness of breath, especially after exertion, and attacks of paroxysmal tachycardia. The first of these came on while he was milking a cow. He went to bed promptly and felt entirely recovered after several hours of rest. Attacks occurred at intervals of seven or eight weeks. During the year before enlistment they became more frequent, coming on at intervals of several days, and more often when the patient "felt exhausted." The attacks began very suddenly. Sometimes they were very short in duration, at other times they lasted as long as thirty-six hours. They always stopped suddenly. After the more lengthy attacks the precordial area remained tender and sore for several days. The patient had no hemoptysis, cough, or edema.

On May 15th the heart was not enlarged. The left border was $8\frac{1}{2}$ cm from the median line and inside the nipple line. The right border percussed at the right sternal border and the apex-beat was in the fourth space. The sounds were normal. The temperature remained normal during the entire period of observation. The urinalysis was negative. The Wassermann test was negative for lues.

Present Attack —On the evening of May 17th the patient was

returning from a short stroll on the hospital grounds when he began to feel short of breath. He lay down and the pulse remained normal in rate until two hours later. He then felt a peculiar "numb sensation" in the precordium and complained of a "fulness in the head." He had no pain and no palpitation or cough.

The pulse at this time was found to be very rapid and weak and could not be counted by palpation. Its rate was 220 a minute. Pressure on the eyeballs and both vagi had no effect upon the heart's action.

Twelve hours after the onset the outermost point of the apex beat and the left border of the heart percussed 11 cm from the midsternal line and at the nipple line. The upper border percussed at the third rib and the right border in the third space was $3\frac{1}{2}$ cm to the right of the median line. There were no murmurs or accentuated sounds. There was no cyanosis and the liver was not enlarged.

About seventeen hours after the onset of the paroxysm the patient was moved with his bed to the x-ray laboratory for a radiogram. The tachycardia continued until the patient returned. He felt much better a few minutes later, and the pulse was immediately found to be slow and regular. Tracings taken soon after showed a pulse-rate of about 96, with no alternation, and normal a-c-v sequence in the jugular tracing.

The patient was not cognizant of the change of rate, but he felt much better. The heart was still slightly enlarged over its normal size. The apex was in the fourth space and the left border percussed 9 cm from the median line. The right border returned to the right sternal border. The systolic blood-pressure now was 104 mm and the diastolic pressure was 54 mm of mercury.

x-Ray examination was made before the end of the attack, with the patient lying on his back. Another examination, with the patient in the same position, was made two weeks later. This showed no difference in the width of the two cardiac shadows. In this case the end of the attack was attributed by the patient to the jarring and noise made in moving the bed through

the corridors. Perhaps the psychic stimulus in taking the radiogram cut short the attack

The patient still continued to suffer with his previous cardiac symptoms. He had moderate dyspnea and palpitation, which were worse on exertion, constant tachycardia, moderately enlarged thyroid, and a moderate thyrotoxic tremor, but without eye signs

Tests were made of the functional capacity of the circulation two weeks after the cessation of the attack described above. Table II presents the data at a glance. The patient was recommended for discharge from the military service

TABLE II

	S.	D.	S.	D.	S.	D.
Pulse-rate, seated	120		120		108	
Pulse-rate, standing	144		138		126	
Blood-pressure, seated	110	70	107	70	110	75
Blood-pressure, standing	105	75	100	75	100	85
Exercise performed ¹	{ Hopping × 100		15 S 46 × 5 ft.		15 × 57 × 5 ft.	
Foot-pounds of work	3750		3450		4275	
Pulse-rate immediately after	120		144		156	
Blood-pressure 30 seconds after	135	70	125	70	125	70
Blood-pressure 60 seconds after	128	68	130	80	115	75
Blood-pressure 90 seconds after	125	74	125	75	115	70
Blood-pressure 120 seconds after	120	70	116	75	112	75
Pulse-rate 2 minutes after	114		114		126	

Polygraphic Study—Polygraphic tracings were taken four and a half hours after the onset of the attack. The pulse rate was 220 per minute (Fig 88). The form of the curve is that obtained in attacks of auricular origin. It shows the marked pulsus alternans so often found in paroxysmal tachycardia. This is due to disturbance of the function of contractility during the period of abnormal rate. The carotid or *c*-wave in the jugular tracing shows very plainly the alternans character of the beat. The phlebogram is of the ventricular form and shows no auricular wave. The cardiogram is triangular with inspiration and trapezoidal with expiration. This indicates the

¹ See note under Table I, page 433. This patient weighed 150 pounds.

dependence of its form upon the mechanical relations between the heart and the chest wall. In Fig 89 the suggestion of an a -wave may be seen following the v at the foot of the c -wave.

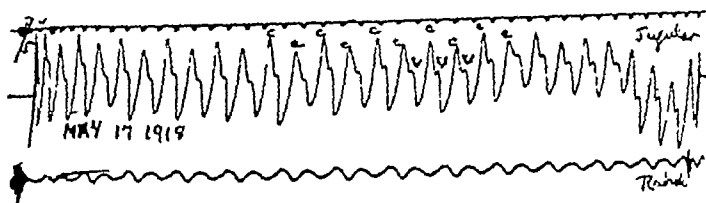


Fig 88.—Simultaneous tracings of the jugular and radial pulsations and of the apex-beat of the left ventricle. Note the distinct pulsus alternans so marked in the radial and carotid waves. The cardiogram shows both the triangular and the trapezoidal form of curve, changing with respiration and relationship of heart to chest wall. The rate is 220 per minute.

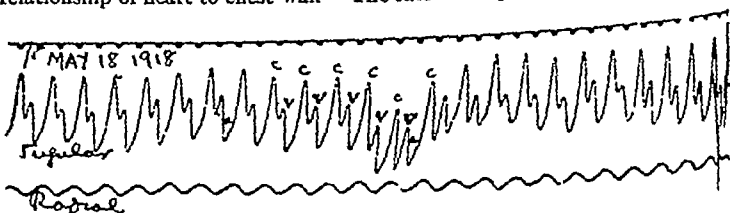


Fig 89

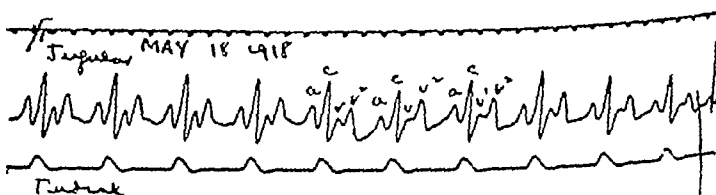


Fig 90.—Return to a slower rate (90 per minute) soon after the attack ceased.

Figure 90 was taken soon after the termination of the attack. It shows the pulse-rate of 90 per minute, with no alternation, and the normal a - c - v sequence in the jugular tracing.

CASE III —Attacks of paroxysmal tachycardia, no cardiac dilatation after eight hours, as shown by x ray, good functional capacity between attacks Private L G B, aged twenty two, was in active service as cook for nine months before he came under our observation in the Base Hospital, Camp Zachary Taylor

Past History —He was a student before his enlistment He had chicken pox and whooping-cough as a child At the age of fourteen he suffered with subacute articular rheumatism during most of one winter, and since then frequent attacks of tonsillitis Six months before his stay in the hospital he had a slight attack of sudden tachycardia, and soon after he had measles and mumps, with bilateral orchitis His family history was negative and his habits good

Previous Attacks —His first attack occurred at the age of eighteen, but he did not recall the exact details of the incident A second attack occurred perhaps six or eight months later, and recurred after half a year Then the paroxysms became more frequent, the intervals varying from one week to six months On the four days before admission to the hospital the patient had an attack each afternoon, lasting about ten minutes

The attacks usually came on after being startled or excited or after sudden or excessive exertion They began suddenly, with a single "thump" in the precordium, after which the heart beat very rapidly and forcefully against the chest wall Every little while, at ten to thirty minute intervals, the heart felt "cramped, as if by pressure of a hand around it." A sharp lancinating momentary pain darted through the chest below the left nipple. During the attacks the patient felt as if "buoyed up or floating on waves" as he lay in bed They continued a varying length of time, and stopped suddenly, giving the same sensation "as when an elevator suddenly starts to descend"

Present Attack —Until noon of July 3d the patient had been working as usual While on his way to dinner he yawned deeply Immediately the attack to be described began, with all the typical manifestations

Physical Examination — On admission the patient appeared to be in general good condition except for his natural pallor and nervousness. The palpebral fissure on the right side was wider than the left and the right pupil was dilated more than the left. There was no dyspnea or cyanosis.

The pulse was too fast to be counted accurately. It was regular, but inconstant in its volume. This is well shown in the

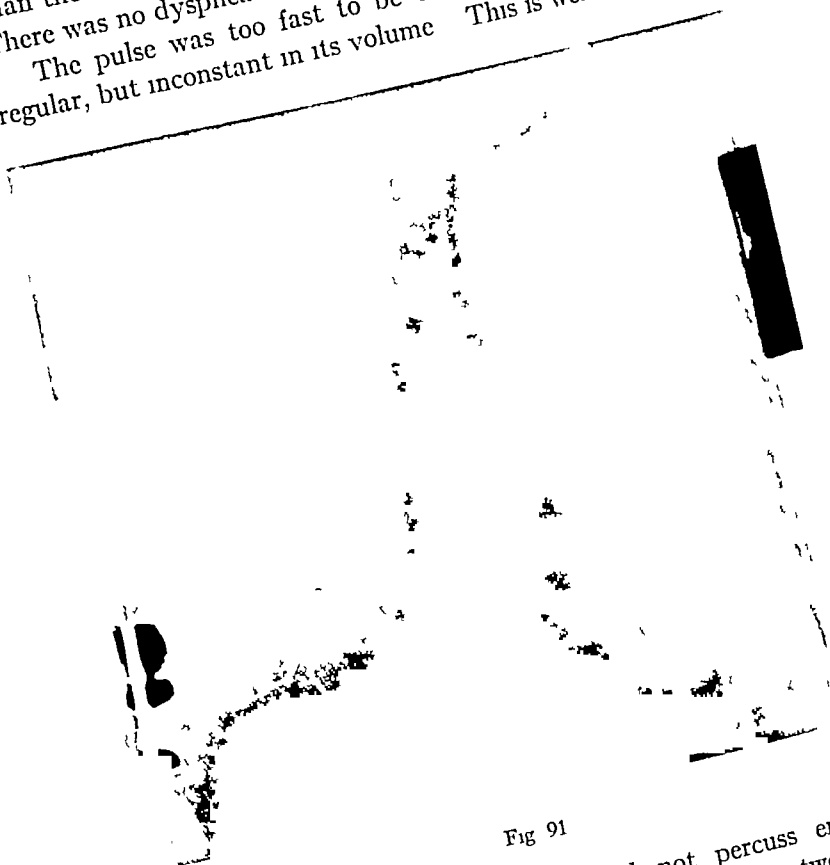


Fig 91

polygraphic tracings. The heart did not percuss enlarged. The apex was in the fifth space. Its left border was two fingers inside the nipple line and 75 cm from the midsternal line in the fourth space. The right border percussed 25 cm to the right of the midsternal line in the fourth space. The sounds were clear. The first and second sounds at the apex were of

equal intensity, and, with the rapid rate, simulated embryocardia. Prolonged pressure on the eyeballs did not affect the heart's action.

The lungs were clear and the liver and spleen were not enlarged. There was no edema of the extremities.

Course—Polygraphic tracings showed a rate of 188 beats a minute.



Fig 92

The blood pressure was taken with the patient lying flat in bed and the arm by his side. The systolic pressure was 69 mm and the diastolic pressure was 49 mm by the vertical mercury manometer scale. With inspiration the systolic pressure fell to 66 mm of mercury, but the diastolic pressure remained unchanged. When the patient sat up in bed no sounds could be

elicited at the elbow to estimate the auscultatory blood pressure with the arm in any position

The respirations varied from 20 to 24 during the attack. The urinalysis and the Wassermann test were negative and the temperature was normal throughout. The entire clinical picture continued unchanged until 8:45 P. M., when the attack suddenly stopped, and the patient felt well. The area of cardiac dulness remained unchanged from before.

Radiographic examination of the heart was made about five hours after the onset of the attack, with the patient lying with his chest on the plate. The tube was $33\frac{1}{2}$ inches from the plate and centered exactly over the spine of the eighth dorsal vertebra (Fig. 91). Another examination was made twelve hours after the cessation of the attack, with the patient in the same position as before, and with the same relations of plate, tube, and time of exposure. There was little difference between the cardiac shadows, which corroborated the clinical impression in this case (Fig. 92).

The patient continued in good condition. After the attack the palpebral fissures and pupils were equal. After three days tests were made of the functional capacity of the circulation. The following data (Table III) evidence the normal functional capacity of the circulation in this case and indicate the height of blood-pressure between attacks.

TABLE III

	S		D	
Pulse rate, seated	72		78	
Pulse rate, standing	84		108	
Blood-pressure, seated	104	50	114	72
Blood pressure, standing	92	38	102	52
Exercise performed ¹	Hopping \times 200 6000		15 S	76 \times 5 ft
Foot-pounds of work				5700
Pulse rate immediately after	144		136	
Blood-pressure 30 seconds after	136	50	122	70
Blood pressure 60 seconds after	136	46	122	70
Blood pressure 90 seconds after	134	52	122	70
Blood pressure 120 seconds after	123	54	114	
Pulse-rate 2 minutes after	90		108	

¹ See note under Table I, page 433. This patient weighed 120 pounds.

A month later the patient was seen at the end of an attack. The pulse was 208 per minute. The patient moved about considerably, but the pulse-rate remained unchanged. He lay down upon the bed with the examiner's hand over the precordium. As he touched the pillow the heart suddenly began to beat slowly and regularly and the patient instantly felt the change. He remained well during the subsequent period of observation, but was recommended for discharge from military service because of the frequency of his attacks.

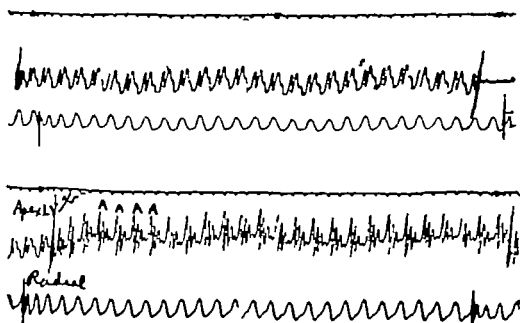


Fig. 93—The figures show pulsus alternans and the effect of respiration on the height of the radial wave. The jugular tracings of the upper strip and the heart apex tracing of the lower strip are self-explanatory.

Polygraphic Study—Polygraphic tracings taken four hours after the onset of the attack on July 3d show the *a-c v* sequence of waves in the phlebogram with a rate of 188 beats a minute (Fig. 93). The cardiogram presents a series of vibrations. The radial wave presents a slight degree of alternation and a distinct respiratory variation in height, that is, the waves are higher during expiration.

The attack suddenly stopped after eight hours of continual tachycardia. Polygraphic tracings taken soon after show the normal *a-c v* sequence in the venous curve with a rate of 68 a minute (Fig. 94). They also manifest a respiratory sinus

arrhythmia and a slight fall of blood-pressure during the inspiratory phase

Discussion—The fall of arterial pressure is a constant finding in all these cases. The reason for this lies in the deficient filling of the ventricles during the very short diastolic periods. The period of ventricular systole is never much less than 0.2 of a second. If the rate is over 200 per minute, as it was in most of the attacks described, the period during which filling of the ventricles can take place is very short. As a result, venous auricular stasis occurs and the arterial pressure falls

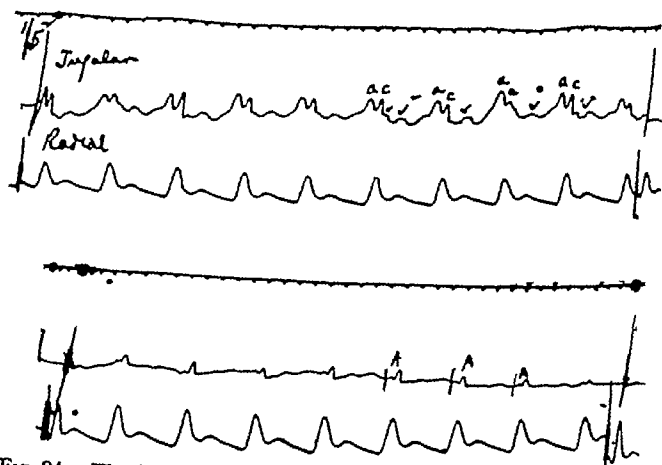


Fig 94—The jugular and heart apex curves are normal in the above figure, taken soon after the attack. The radial still shows the inspiratory drop of systolic blood-pressure

The area of cardiac dulness may increase, as in Cases I and II, with continuation of the attack. Usually, however, the tonicity of the heart muscle is increased and the area of dulness is lessened or remains at least unchanged. The radiographs in Case III show this pointedly.

The latter case also illustrates the following distinguishing feature between paroxysmal and simple tachycardia. Lewis has shown that effort has no effect on the rate in paroxysmal tachycardia, while it increases the rate in other tachycardias.

CASE IV—Frequent attacks of paroxysmal tachycardia cut

short by pressure on the eyeballs C R S, aged twenty-seven, was in Camp Zachary Taylor for nine months

Past History—He was a farmer for several years, doing, however, very light work. He had mumps, chicken pox, and whooping-cough in childhood. He sustained severe injuries in a cyclone when he was eight years old. When sixteen he had pneumonia. He denied venereal infection and gave a negative family history. His habits were good.

Previous Attacks—The patient remembered having had attacks of paroxysmal tachycardia since he was fourteen years old. The mode of onset was described "as if the heart stops still or is suddenly caught in a vise." This sensation was momentary and was immediately followed each time by the heart fluttering against the chest wall. At the same time there was tingling in the fingers and a feeling of aching and oppression in the chest. Sometimes the patient was dizzy at the onset. The patient stated insistently that everything in his sight took on a green color during the paroxysms.

The patient had no attacks for three years prior to enlistment in the army. Two months after entering the service a typical paroxysm occurred. After walking brusquely for a mile the patient suddenly felt warm and fell to the ground exhausted with the onset of an attack. After he rested for two hours the attack stopped as suddenly as it began. He later developed measles and pneumonia, from which he recovered without complications or cardiac manifestations. He felt, however, too weak for the regular drills after that. He was well for three months.

One night, while complacently seated, he fell to the floor, but did not lose consciousness. He felt as if a heavy weight had suddenly struck his chest, and when he tried to rise he could not support himself. He had no headache, cough, or vomiting, and felt well after the attack abated. He had several attacks before coming under our observation.

Present Attack—He felt fairly well when first admitted to the Base Hospital on June 22d. One morning, after doing some light work in the ward, he had a sudden attack lasting three hours. He complained of feeling weak one afternoon. The

pulse was normal in rate. Suddenly it became rapid and uncountable for several seconds, and then resumed a slower rhythm. The polygraphic tracings were normal (Fig. 95).

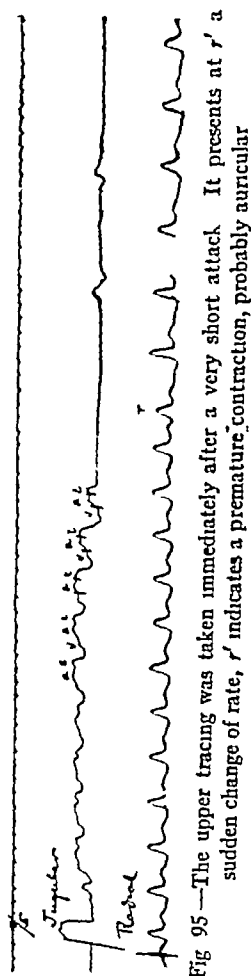


Fig. 95—The upper tracing was taken immediately after a very short attack. It presents at r' a sudden change of rate, r' indicates a premature contraction, probably auricular.

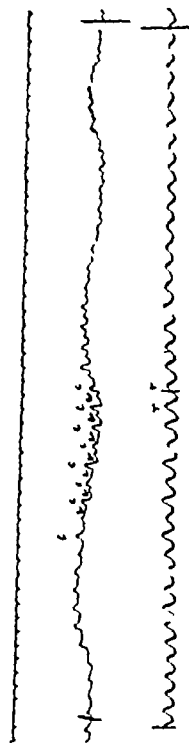


Fig. 96—Hopping on one foot 30 times precipitated an attack. The tracing was taken immediately after the onset, and shows a rate of 222 beats a minute and marked pulsus alternans.

The patient was then instructed to hop on one foot. When he hopped 30 times he remained motionless, later describing a peculiar "numbness of his whole body," but did not turn pale. He was laid on the bed with a paroxysm of tachycardia and the tracings were continued (Fig. 96).

Continuous pressure was then made on the right eyeball for thirty seconds. The effect of this is apparent in the tracing and will be analyzed below (Fig 98). The pulse-rate fell from 240 to 206 per minute. The moment when this change occurred is indicated in the figure by two or three waves showing exaggerated alternation. The pulse soon returned to 258 per minute. Pressure on both eyeballs was made for about two minutes and the attack stopped suddenly, having lasted fifteen minutes.

Another attack occurred five hours later. The patient felt suddenly dizzy and lay down in bed. This attack was also stopped after seventy minutes by pressure upon both eyeballs. Figure 100 shows graphically the sequence of events during this study.

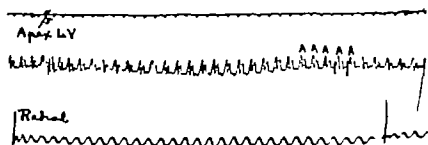


Fig. 97—The apex curve is trapezoidal in form. It presents a series of three waves difficult of exact analysis.

There were no other data of clinical importance. Radiographic examination showed a normal heart shadow when the rate was normal. The patient was discharged from the hospital after a short period of observation and recommended for domestic service.

Polygraphic Study—The analysis of the polygraphic curves in this case reveals a number of interesting features.

Figure 95 shows the first tracings obtained in this case. The upper strip was taken immediately after a short attack. Following the twelfth rapid normal beat a premature beat occurs at r' . The $r-r$ intervals before this are about three-fifths of a second, the rate being about 100 per minute. The extrasystole initiates a slower rhythm in which the $r-r$ interval is about four-fifths of a second, the rate being about 75 per minute. The pause following r' is equal to the interval between

each of the subsequent beats. The *a-c* interval is about one-fifth of a second, which is normal. The jugular tracing is, un-

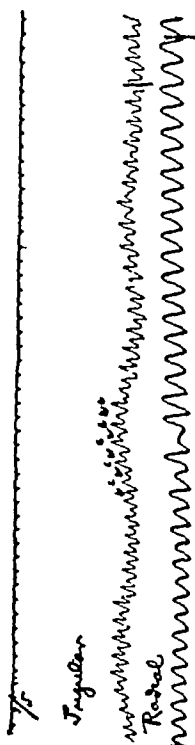


Fig 98—After continuous pressure on the right eyeball for sixty seconds there was a sudden exaggeration of the alternans character of the radial pulse wave and a sudden fall in rate from 240 beats a minute to 206 beats a minute. The alternation was most marked at the moment of the change of rate, for three or four heartbeats. It continued at the lesser rate for a short time after the pressure was removed.

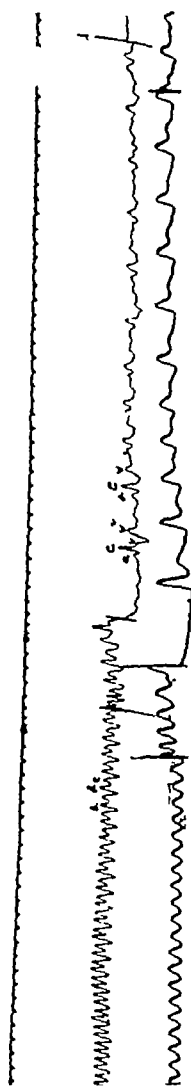


Fig 99—The pulse-rate soon returned to 258 a minute, as shown in the left portion of the tracing. Pressure on both eyeballs for 120 seconds stopped the attack suddenly, and the sinus promptly regained control. This is shown in right portion of the above tracing. The lower strip shows the sinus and respiratory arrhythmia that so commonly follows the attack of paroxysmal tachycardia.

fortunately, not complete, but there can be little doubt that we are dealing with an auricular extrasystole.

After the patient hopped 30 times a paroxysm commenced. This is shown in Figs. 96 and 97. The pulse-rate is 222 beats a minute, and it shows a distinct pulsus alternans. The phlebogram indicates the auricular origin of the paroxysm. The cardiogram is trapezoidal in form. It presents a series of three waves, difficult of exact analysis.

Continuous pressure was made upon the right eyeball for thirty seconds. The effect of this is shown in Figs. 98, 99. The pulse-rate fell from 240 to 206 beats a minute. The moment when this change occurred is indicated in the figure by two or three pulse-waves showing exaggeration of the alternans character. The pulse-rate soon returned to 258 beats a minute. Pressure was made on both eyeballs for about two minutes. The attack then stopped quickly, having lasted altogether fifteen minutes. The sinus soon regained control of the heart beat. The polygraphic machine was interrupted inopportunistically as the attack ceased. However, it is seen in the second part of Fig. 99 that the paroxysm terminates in a prolonged pause followed by resumption of normal *a-c-v* sequence. With regard to the prolongation of the first beat following the paroxysm, a slow sinus rate, with a gradual return to the normal as a sequence to a paroxysm, was a constant phenomenon in 2 cases observed by Lewis. In Laslett's case and in a case reported by Falconer and Duncan the first normal pulse period was prolonged.

Figure 100 shows the second attack with a rate of 210 beats per minute. It also shows marked alternation, and the period of the end of the attack. The rate after the attack stopped was 114 beats per minute. The attack was stopped by pressure on both eyeballs for about sixty seconds. No tracing was taken while the pressure was made.

Discussion.—Six cases of paroxysmal tachycardia in soldiers in France were recently reported by Hume. None of them showed endocardial lesions. The venous tracings from all of the cases had very similar characteristics, in each there were either one or two waves which fell in the period of ventricular systole, and in none could a separate "a" wave be detected, as evidence of auricular contraction. The polygraphic and elec

trocardiographic studies made on these cases suggested that the attacks were of ventricular origin. This view was supported by the appearance of frequent extrasystole in one case during the non-paroxysmal periods. This finding contrasts with the usual infrequency of the ventricular type of paroxysmal tachycardia. In the majority of cases the abnormal site of origin of the paroxysm is in the auricle. Of 17 cases studied by Hart,

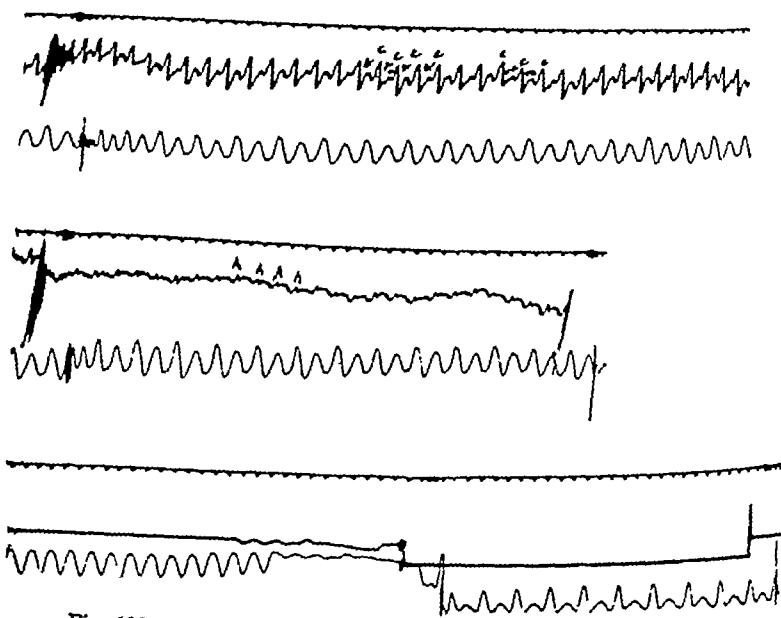


Fig 100—Polygraphic tracings showing marked alternation in the radial and the auricular character of the jugular wave. The rate is 210 a minute. The σ -c interval is much reduced below normal. The apex curve is trapezoidal in form. The attack was cut short by continuous pressure upon both eyeballs for sixty seconds.

only 1 was of ventricular origin, and of 18 cases reported by Vaughn, only 2 were ventricular.

CASE V—Attack of paroxysmal tachycardia due to auricular flutter, effect of the vagus upon heart action shown by the oculocardiac reflex, excellent functional capacity of the circulation after the attack. H A O, aged twenty-nine, was a physical director in Camp Zachary Taylor.

Past History—He had measles, chicken pox, whooping-cough, and mumps in childhood, and occasionally sore throat. He drank alcoholic beverages in moderate amounts until several years before coming to camp. His family history was negative and he denied venereal infection.

Previous Attacks—The patient had attacks of cardiac disorder since he was fourteen years old. The first attack followed a strenuous bicycle ride. Palpitation lasted about a half hour, during which the patient rested. He was then able to resume his ride entirely recovered. He felt well until the time of onset of the war. He worked strenuously at his usual occupation.

In 1915, during a basketball game, he felt the tremulous movement of a rapid pulsation in the neck. He was not dyspneic or weak, but soon felt palpitation. After one hour this attack stopped suddenly. Six months later, while leading his class in an exhibition of physical training, another attack came on. This lasted about one hour and stopped during the continuation of the exercise.

About a year and a half later the patient had his severest attack. This followed strenuous gymnasium drill. The attack consisted of a "rapid pounding in the chest" and lasted eighteen hours. It stopped suddenly following the administration of aconite. The patient had no dyspnea or pain with any attack and never fainted. He was well again for two months and then had a short attack which occurred during physical exercise and lasted half an hour.

The attack for which the patient was admitted to the Base Hospital began during a game of volley ball at 7 A. M. on August 8th. The patient felt the sudden onset of palpitation and was admitted to the ward after two hours of comparative rest.

Physical Examination—Throughout the attack the patient appeared in excellent general condition, with good color, normal temperature and respirations, and normal clinical laboratory analyses. The pulse was very irregular and rapid. The blood pressure was taken with the patient lying flat on his back and his arm by his side. The systolic pressure was 104 mm. and the diastolic was 86 mm. of mercury by the vertical manometer reading

The apex-beat was in the fifth space. The left cardiac border percussed at the outer margin of the left nipple in the third and fourth space 10 cm from the midsternal line. The right border in the third space was 2 cm to the right of the sternum. The upper border was at the upper border of the third rib. There were no murmurs. The basic sounds were weak. The heart action was apparently entirely irregular, with frequent extrasystoles. For short periods regular beats of greater rapidity seemed to occur. The physical examination was otherwise negative.

The patient felt generally well and was able to walk about with his usual alertness. After exertion the pulse-rate became only slightly more irregular, and the polygraphic tracings taken during the course of the attack are very interesting.

The attack subsided one-half hour after the last tracing was made and a few minutes after the administration of the first dose of tincture of digitalis—to which the patient naturally attributed his recovery. He felt a sudden change of rhythm, and a “thumping” in the precordium for a few seconds. The heart then beat normally. The attack lasted fifteen hours. Two days later showed normal capacity of circulation (see Table IV).

The patient was discharged well.

TABLE IV

	S	D	S	D
Pulse-rate, seated	96		84	
Pulse-rate, standing	120		108	
Blood-pressure, seated	112	66	104	74
Blood pressure, standing	102	80	84	74
Exercise performed ¹	15 S	6 ft × 60	Hopping × 125	1 ft
Foot-pounds of work		5400		9125
Pulse-rate immediately after	120		132	
Blood-pressure 30 seconds after	128	72	158	72
Blood-pressure 60 seconds after	122	72	156	74
Blood-pressure 90 seconds after	120	78	142	72
Blood-pressure 120 seconds after	122	78	140	68
Pulse-rate 2 minutes after	120		120	

¹ See note under Table I, page 433. This patient weighed 146 pounds.

Polygraphic Study — Polygraphic tracings were made ten hours after the onset of the attack and repeatedly after that.

The tracings show an apparently absolute irregularity of the pulse. On closer study, however, the characteristic features of the auricular flutter are revealed. Except for the evidence given by the graphic curves, it would have been concluded that the case was one of paroxysmal tachycardia due to auricular fibrillation. Even despite the tracings with the rapid auricular rate it might be that the case is not one of flutter.

Figure 101 shows three strips from the jugular tracings taken ten hours after the beginning of the attack. The venous curve shows very distinctly the waves due to auricular contraction, marked *a-a-a*, etc., during ventricular diastole. In all the strips the same auricular rate is evidenced. In the third tracing, during ventricular diastole, the impulse due to auricular flutter was transmitted to the radial artery through the open mitral foramen and down through the aortic semilunar valves.

In this form of tachycardia the ventricle necessarily cannot respond to each auricular wave. It may respond to every second or third beat or quite irregularly. Regular beats may follow each other or may frequently recur, that is, the *r-r* intervals will have a certain time relationship to each other and also to the *a-a* period. This is well shown in all the tracings from this case during the attack. In Fig 101 the equal radial pulses are indicated by similar markings in each separate strip underneath the radial curve. The marked *r-r* interval in the middle strip is equal to the sum of two of the * plus one π interval. Figure 102 shows a series of six equal beats in rapid succession at intervals corresponding to three auricular contractions. The rate of the pulse during this series is 125 and the auricular rate computed from this is 375 beats per minute.

Uniform digital pressure was made underneath the supra-orbital ridge upon the left eyeball. This was begun simultaneously with the tracing indicated by the arrow in Fig 103, and stopped at the point indicated by the arrow in Fig 104. The figures are continuous. The total time of the ocular pressure lasted forty-seven seconds. The first effect of the pressure

upon the left eyeball is shown after twelve seconds, when the auriculoventricular block becomes longer than in any previous tracing. It equals at $r-r$ an interval of about 12 auricular con-

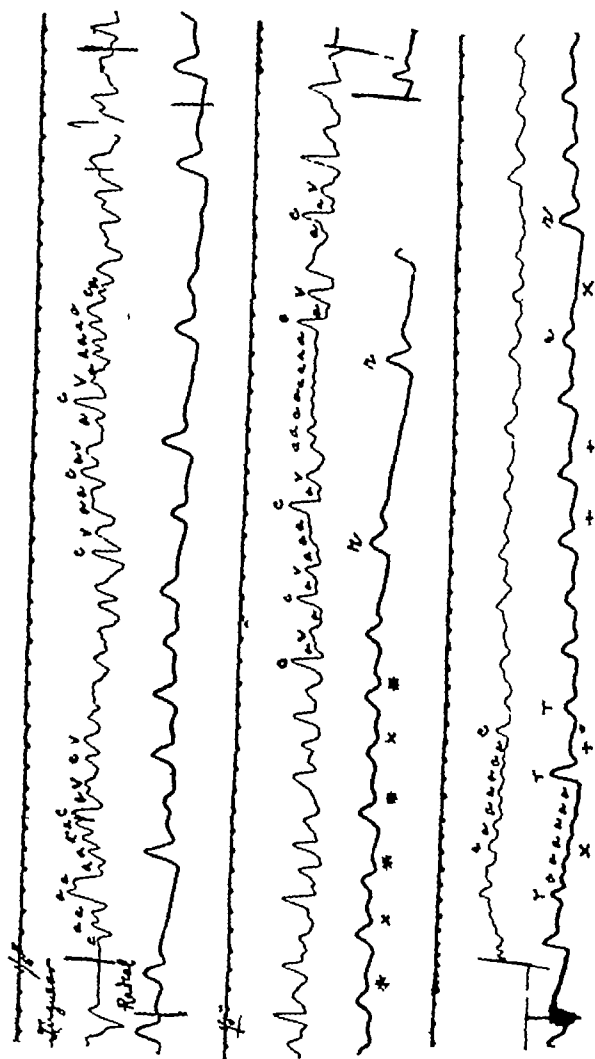


Fig 101

tractions After eight seconds more the $a-v$ block equals 1 to 14 auricular contractions at r^1-r . After four seconds more it equals about 1 to 20 at r^2-r , then 1 to 24 at r^3-r after one second

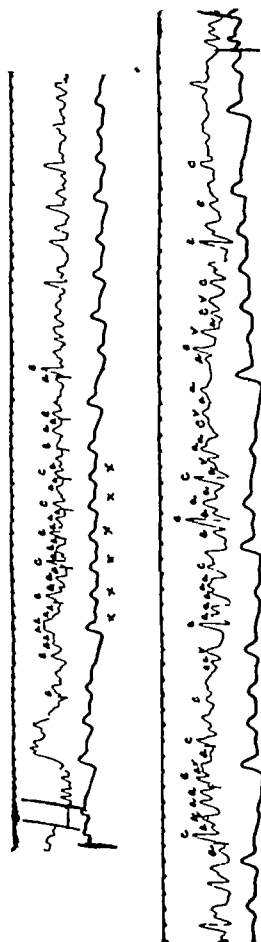


Fig 102

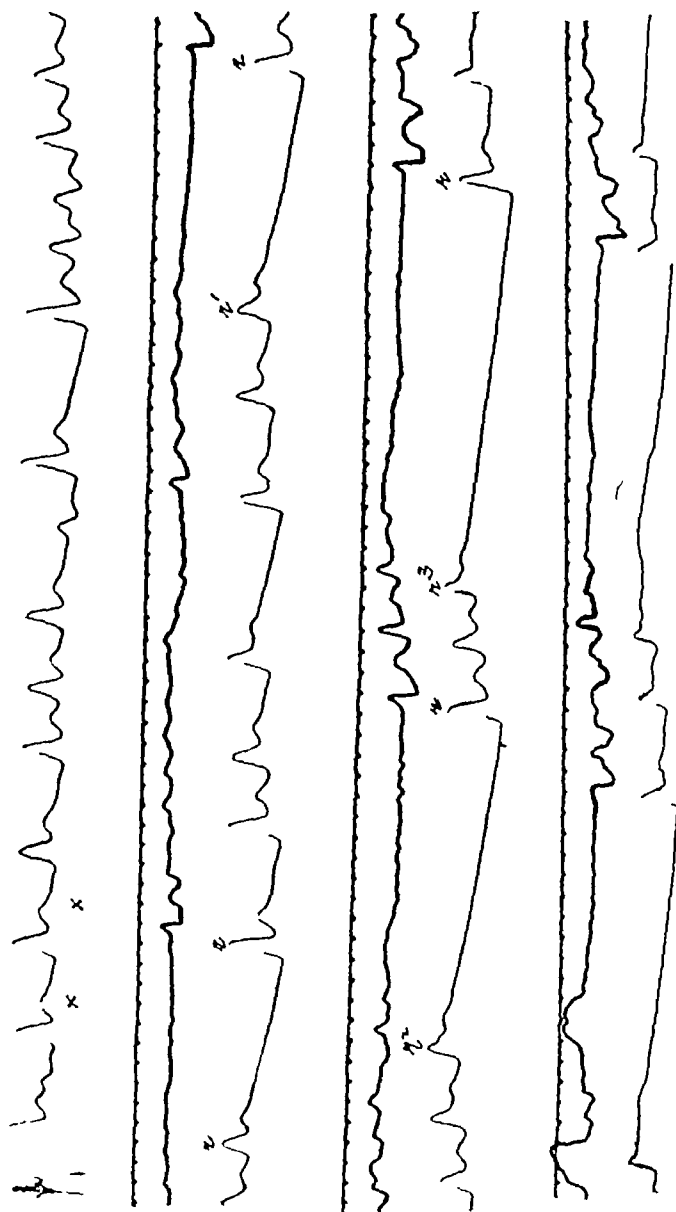


Fig 103

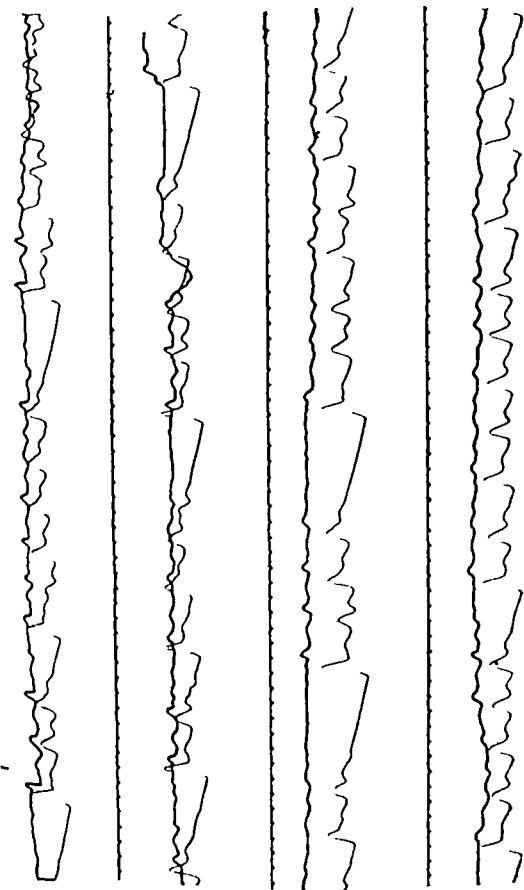


Fig. 104.

The auricles remained practically independent of vagus control and could not be inhibited by pressure on the eyes

Pressure was then made upon the right eyeball to about the same degree as previously upon the other eye. It was begun thirteen seconds before the beginning of Fig 105. The first evidence of any pressure oculocardiac effect occurs in about forty-one seconds, *i. e.*, at *r-r*. After three seconds more an interval of 24 auricular contractions is blocked. The pressure was then stopped and recovery was prompt. What is clear in this comparison between the ocular pressure on the left and right eye is that pressure on the left eyeball is about three times as prompt in its cardiac effect as the right eye.

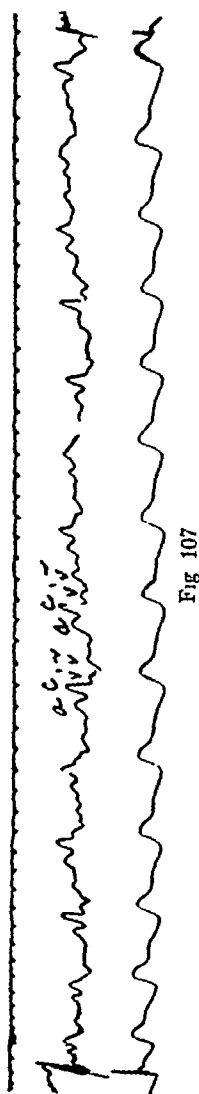
Still another tracing (Fig 106) was made during binocular pressure. The depression of cardiac conductivity is noticeable at *r-r* after seven seconds and progresses as long as the pressure lasts.

The attack subsided one-half hour after the last tracing was taken, having lasted fifteen hours. The tracing taken then shows normal rhythm and regular *a-c-v* sequence in the jugular curves (Fig 107).

Discussion —Dagnini in 1908 called attention to the bradycardia that develops on compression of the eyeballs. This seems to be the most potent means at our command to influence the vagus, and thus indirectly control heart action. It produces all the changes in rate, rhythm, and conduction which follow vagus pressure in the neck. The path of the

reflex is considered to be along the fifth cranial nerve, the medulla, and the vagus.

Liau first proposed to utilize this reflex as a means to arrest



paroxysmal tachycardia. Cohn and Fraser reported 2 cases, one of supraventricular or auricular origin and one of doubtful, possibly ventricular, origin, in which the effects of vagus compression were observed. The case of supraventricular tachycardia yielded easily to right vagus compression, but did not yield when the left vagus was employed. In the second case of doubtful, possibly ventricular, paroxysms, the attacks were stopped by left vagus pressure with great facility, and only with great difficulty by compression of the right vagus.

Robinson reports observations on 2 cases of paroxysmal tachycardia in which the rapid heart rate could not be influenced by vagus pressure. These are representative of those cases in which vagus pressure fails to abolish the tachycardia. The first 3 cases of our presentation belong to the same category. The cause of the ineffectiveness is not, however, any permanent derangement of the cardiovagal inhibitory mechanism, because, as in Case IV above, the heart-rate was slowed by vagus pressure, and, as in Robinson's case, increased by vagus paralysis with atropin. Robinson regards these cases as evidence that the influence of the vagus differs in degree on different parts of the heart, and that this difference probably depends on the anatomic distribution of both nerves.

Comment.—Cases of this type, in which the symptoms are periodic and paroxysmal in occurrence, usually pass undiscovered through the review given by the cardiovascular boards examining the troops.

In the examination made of troops by Feil, at Camp Dodge, by Smith, at Camp Custer, and by Butler, at Camp Mills, of a total number of about 85,000 soldiers, no case of paroxysmal tachycardia was encountered. In my own survey of about 27,000 recruits as a member of the board at this camp during the month of April, I was fortunate to observe 2 cases of paroxysmal tachycardia during an attack. The pulse-rate suddenly rose to 180 a minute in one patient soon after he entered, but the attack ceased by the time he was admitted to the Base Hospital. In the second case the pulse-rate was too fast to count

when the patient came in, and it was especially noted that the heart showed no murmurs. The following day, when the rate returned to normal, there were unmistakable signs of aortic regurgitation, on which account the patient was rejected from the army. This case illustrates the observation of Bard, that even the most pronounced of official murmurs are liable to disappear during an attack of paroxysmal tachycardia.

Usually, however, as in the series of cases here reported, the soldier is taken with an attack after a short period of military service and remains under observation in the hospital.

The medical literature, both French and English, especially during the last two years, presents a great deal of discussion of the war tachycardias.

Aubertin, in a recent study, emphasizes particularly the point that in most of these tachycardias, in which no lesion can be discovered in the heart, the patient is less adapted for military service than even with organic valvular lesions. This conclusion is also reached by Crouson and Mauger. They show that in a large number of these cases the tachycardias are caused by an infectious, organic, and latent heart lesion which may have antedated the war. According to them, these cases cannot be considered as merely functional. From a military viewpoint those cases, placed in a pathologic category, must be considered as having a lessened availability for war service.

Discussions and observations on this subject are also published by Dinet and Lewis and Pende. In the 6 cases of paroxysmal tachycardia reported by Hume, 3 of the soldiers had suffered from attacks before enlistment. In 4 of the cases attacks could be induced by slight exertion.

From the military standpoint, of course, the most important consideration is the determination of the serviceability of the soldier in the army, either at full duty or in a limited capacity, or whether the soldier should be rejected from military service. In general, the decision depends upon the proper and rational balancing of (1) the efficiency of the soldier and his value to the service, against (2) his ineffective days and his physical defects.

There are a number of important factors to be taken into consideration

1 *The Frequency of Recurrence of the Attacks*—A reliable history is of assistance in this connection. No statements of the soldier should, however, be accepted as proof of the disorder unless supported by objective evidence. If the soldier has had attacks often, entailing his frequent returning to the hospital, as in Cases II and III, reported above, he may be considered useless to the service and even a burden upon it, and should be rejected. If the attacks are only occasional, as in Cases I and IV, in which two and three years respectively elapsed between paroxysms, the soldier is serviceable in the army. His work, however, should be limited to domestic and not overseas duty.

When the attacks are few and far between the heart does not seem to suffer. This is illustrated by those cases which showed a normal functional capacity in the intervals. But if the attacks grow longer and more frequent, the myocardium does suffer structurally as well as functionally.

2 *The Severity of the Attacks*—Mild attacks, or those lasting only a few cycles of the heart beat, may give very little symptoms beyond the uncomfortable precordium sensation. Severe attacks, lasting several days and with cardiac dilatation, deserve more liberal consideration when the question of serviceability arises.

3 *Valvular Defects that May Be Associated*—These are to be dealt with, in general, according to the principles laid down in Circular No. 21 of the War Department. Definite organic valvular lesions in themselves exclude an individual from active military service. No special mention of paroxysmal tachycardia is made in the circular.

4 *Myocardial Defects*—Paroxysmal tachycardia may imply myocardial damage. The electrocardiograph should be of great assistance in determining this point in any particular case, to review abnormalities in the shape of the P wave or of the Q-R S complex, and to show defective conductivity in the bundle of His or its arborizations.

5 *The Cardiovascular Response to Exercise*—This should be

obtained between attacks. Several different tests should be employed, and all findings should be co-ordinated before judgment is passed on the individual case. The delayed rise of blood-pressure after a measured amount of exercise is a fairly accurate measure of the cardiovascular response. We have just completed a study of the comparative value of a number of tests in estimating the functional capacity of the circulation in newly recruited soldiers, and we are analyzing and comparing the data for publication. Functional tests between attacks of paroxysmal tachycardia are of assistance in deciding whether a soldier is to be rejected or kept for domestic duty. It is to be noted that in Cases I, II, III, and V the functional capacity was excellent soon after the attack. There was no tachycardia. The pulse-rate varied little between the sitting and standing postures. There was no delayed rise of blood-pressure after 6000 foot-pounds of work. In Case IV, on the contrary, there was persistent tachycardia and instability of the pulse-rate blood-pressure, shown in the table, after 3450 foot-pounds of work.

SUMMARY

- 1 Five cases of paroxysmal tachycardia in soldiers are reported. The first 4 are of auricular origin, with typical polygraphic tracings. Case V is apparently due to auricular flutter.

- 2 The outstanding characteristic features are: The sudden onset of the attacks, the extreme tachycardia, the varied sensations associated with the heart's rapid action, the low systolic and diastolic blood-pressure, both during the attack and in the intervals, the marked respiratory variations of systolic pressure, and the sudden cessation of the attacks.

- 3 The polygraphic tracings are characteristic and assist in the diagnosis of the cases.

- 4 The importance and value of functional tests of the circulation are emphasized as being of decided help in the proper disposition of the cases.

- 5 Some of the more important factors are presented upon which to base the determination of the serviceability of the soldier suffering from this malady.

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POSTOPERATIVE PNEUMONIA

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IN the effort to lower the incidence of pneumonia at Base Hospitals each of the various etiologic factors of the disease must be investigated. To the laboratory worker the most hopeful and certainly the most original avenues of attack are afforded, but in many directions clinicians may abolish harmful salients. One of these salients which can and should be almost eradicated is made up of postoperative pneumonia.

Postoperative pneumonia constitutes no mean share of the total pneumonia incidence at a Base Hospital. Between September, 1917, and August, 1918, 485 cases of pneumonia have occurred at Camp Devens, and among this number the post-operative cases amount to 30, or 6 per cent.

The incidence of postoperative pneumonia among 1423 patients operated upon has been 2.1 per cent. This may be compared with 2.2 per cent. reported by Whipple,¹ from the Presbyterian Hospital in New York, and with Risley's² figures, 1.5 per cent., for the Massachusetts General Hospital. They do not compare favorably with Krönlein's statistics, cited by Homans,³ which show an incidence of 0.56 per cent. for 1409 operations.

Such comparisons are, however, unfair to the authors quoted, because they dealt with patients of all ages and classes in large general hospitals, whereas at a base hospital all are young and supposedly healthy.

The percentage of postoperative pneumonia in the total operations per month is given in the following table

¹ Medical Record, 1916, vol. 89 page 531

² Boston Med. and Surg. Jour., January 20 1910

³ Johns Hopkins Bulletin 1909 vol. 20 page 125

POSTOPERATIVE PNEUMONIA ARRANGED ACCORDING TO MONTHS

Month	Total operations	Postoperative pneumonia.	Percentage.
October	81	2	2½
November	94	0	0
December	70	0	0
January	108	3	3
February	121	1	1
March	170	5	3
April	163	4	2½
May	206	4	2
June	216	5	2.3
July	157	5	3.1
August 1-12	37	0	0

Although writers generally have observed that the incidence of postoperative pneumonia corresponds with the incidence of pneumonia as a whole, and, therefore, is generally most frequent in February and March, this would not appear to have been the case in our small series. There would seem to be no relation between the incidence of pneumonia in these cases and the general incidence of pneumonia in the camp, the atmospheric conditions, or the time of year. All of these cases were subjected to a careful physical examination by the Ward Surgeon on the day before, and no impairment of respiratory tract discovered. In 3 of them, however, there had been a recent respiratory infection. One had just recovered from a mild attack of measles, another had been admitted to the hospital with an acute catarrhal pharyngitis six days before admission to surgical service, and one who had a cough with few râles in the chest was held under observation six days before operating. Although in all the physical signs were normal at the time of operation, it is certainly worthy of note that 10 per cent of the series had had a definite history of condition predisposing to lung infection.

It is also significant that in cases in which one or more observations of respiration were recorded on the briefs, the number of respirations per minute is less than 19 and none over 20—in marked contrast to the cases admitted for pneumonia as compiled by Lieut. Gray of the medical service of this hospital, which show an average of over 24 respirations per

mmute. It would seem unlikely, therefore, that there was any preliminary infection when the operation was undertaken.

The type of operation in the 30 cases who developed pneumonia was as follows 1 Abdominal, 21 (hernia, 14, appendicitis, 7) 2 Genito-urinary, 2 (phimosis, 1, varicocele, 1) 3 Miscellaneous, 7 (hemorrhoids, 1, abscess of neck, 2, varicose veins of leg, 1, phimosis, hemorrhoids, and fissure of anus, 1, operation for hernia and varicose veins, 1, and one doubtful case after tonsillectomy)

It will be seen that 75 per cent of the cases developed after abdominal operations, and that two-thirds of these, or approximately one-half of the total number of cases, are subsequent to operations for hernia. The large number of cases following abdominal operations is significant in that it conforms to the statistics of other authors. It is partly explained by the prolonged anesthesia. This would seem likely, because from out of a total of 504 otolaryngologic operations occurring during the same period at this Base Hospital, in the services of Major Knowles, M C, there was but one case which developed postoperative pneumonia. Otolaryngologic operations consume, as a rule, but little time, patients are less deeply anesthetized, and recovery from the anesthetic is more prompt. On the other hand, it is surprising that the pathologic condition of the upper air passages in throat operations does not counterbalance these advantages. The interference with respiration caused by operations upon the abdomen and the deeper anesthesia are also factors which help explain the preponderance of postoperative pneumonia in connection with laparotomies.

The method of anesthetization was ether by the open drop method with a preliminary subcutaneous injection of morphin and atropin one hour before the operation in 28 of the cases. One case was operated upon under cocain, and in one instance no anesthetic whatsoever was employed. The amount of ether averaged 220 gm per patient, the limits being 90 and 320 gm. The duration of the period of administration of the ether averaged fifty five minutes. The shortest etherization was eleven minutes and the longest three hours.

The same anesthetist administered ether to 8 of the cases, 7 anesthetists had 2 cases each, and the remaining 6 cases were etherized each by a different individual

One surgeon operated upon 8 cases, another upon 4 cases, one upon 3 cases, two upon 2 cases, and the remaining 9 cases were operated upon each by a different surgeon

The onset of the pneumonia in one-third of the cases apparently took place upon the same day as the operation. This conclusion was reached after a careful study of the temperature charts and the individual record. The average of the highest respirations observed within forty-eight hours of the onset was 27.4. Sixteen cases showed an onset on the day following operation, whereas the other 4 cases developed between the second and sixteenth days. The early development of the pneumonia is striking, and indicates the close relation to the operation. In this series of postoperative pneumonias the disease originated not as a result of stasis and gradual infection in an exhausted patient, but rather as a primary acute infection.

The diagnosis of pneumonia was made in a third of the cases the first day following the onset, in 7 cases two days after onset, and in 5 cases on the third day. One case was diagnosed on the fourth day, 2 on the fifth, 2 on the seventh, and 1 on the ninth. Only 1 case was diagnosed upon the day of onset. This suggests that it might be well for a clinician from the Medical Service to be attached to the Surgical Service as a liaison officer. His task would be not only to examine all surgical patients before operation but also to follow them up until the pneumonia danger is past. The position would certainly be an interesting one and could not but be of value. At present, though consultations are frequent, the medical officer from his transitory association with the case frequently fails to make a diagnosis as early as his surgical colleague.

The type of organism in half of the cases in which this was determined was Type 4, 3 cases proved to be Type 3, and four to be Type 2. Whipple found 77 per cent of his series of cases to be Type 4.

The lobe of the lung affected in 13 of the cases was the lower

lobe on the right side, quite in conformity to the anatomic relation of the bronchus on that side. In 7 others the lower lobe on the left side was the one involved. Four cases showed disease of both the lower lobes and 2 presented an involvement of both the right upper and lower lobes, and 1 of both lobes on the left side. In the remaining case the upper right lobe alone was attacked. It is also noteworthy that 28 of the cases were lobar in type and only 2 were diagnosed as bronchopneumonia. This also corresponds to Whipple's findings and differs from what the earlier literature would lead us to expect. Perhaps this is to be explained by the more frequent use of the x ray as a means of diagnosis both in his series and ours.

Leukocytosis was usually present and averaged 15,000. In one case, however, the number of white blood-corpuscles was reported to be 4300.

Complications occurred in 12 cases. In 8 this took the form of pleurisy. One case developed phlebitis of the left leg, 1 a severe pharyngitis, 1 a furuncle on the left side of the face, and in another a subphrenic abscess appeared probable.

The outcome of the 30 cases was strikingly favorable. It compares well with Graves,¹ statistics, which are based upon a series of cases largely non suppurative, and, as to be expected, is distinctly better than the figures of large hospitals founded upon a mixed series of cases. The reason for this appears to be, first, that none of the operations were septic in type, and, second, that in none were the patients weakened by disease. Twenty-one cases, or 70 per cent., were discharged well, 5 cases as improved, while 1 case remains unimproved, though the lungs are normal. He has been recommended for discharge from the army on account of phlebitis. One patient is still convalescent. Two cases died, one on the sixth day after the onset of the pneumonia, and the other sixteen days from the onset. The autopsy in these 2 cases revealed the following conditions. One case showed the pneumonia of the upper and lower lobes on the right side, an acute, fibrinous pleurisy on the left side, emphysema and edema of the lungs and fatty infiltra-

¹ Boston Med. and Surg. Jour. 1910 vol. 163 p. 497

tion, and passive congestion of the liver The second case presented complete pneumonia of the right chest, acute purulent pericarditis, as well as an acute right serofibrinous pleurisy The upper right lobe also contained an abscess There was an acute splenic tumor The right kidney showed hydronephrosis and there was a double diverticulum of the right ureter

The striking feature in these cases would seem to be the incidence of pneumonia in perfectly healthy adults after simple uncomplicated operations The case in which it followed cocaine anesthesia and one in which no anesthetic at all was used must be regarded as accidents They were cases of simple cervical abscess in which the operation of incision and drainage was too insignificant to have been of influence in causing or modifying the subsequent pneumonia In the remaining 28 cases in which ether was administered the anesthetic was from three different manufacturing chemists, so that its make was not a causative factor

That the percentage of cases developing pneumonia ran very evenly through the different months as compared to the general incidence of pneumonia, that none of the cases presented before operation any physical signs of lung infection, and that the pneumonia developed with different makes of ether given by different anesthetists, makes it fairly clear that its incidence is not the result of the general prevalence of pneumonia, of an impending or potential pneumonia present at time of operation, or of the kind of ether or the presence of an infection in the etherizer The factors that are common to all the cases are increased secretions of mouth and throat and upper air-passages, deep breathing, and an absence of laryngeal as well as bronchial reflexes Our mouths and throats are always carriers of infectious organisms Even with the most careful etherization the possibility of inhaling the secretions from the throat and upper air-passages is always present In difficult anesthetics and without specially trained and experienced anesthetists the chances of such an accident constitute a real danger Our observation would seem to us to indicate that these postoperative are really inhalation pneumonias and that the administration of the an-

esthetic, the exposure of the patient to cold and wet during the operation, and his care until full consciousness is restored, are the important factors to be considered in studying the means of prevention. Preventive methods should accomplish much against this type of pneumonia, and Army Hospitals afford a splendid opportunity to put them in force. Organization of both the medical and surgical services and hearty and close co-operation between the two with this end in view should yield results. As previously mentioned, a member of the medical service might profitably be asked to examine the respiratory tract carefully before the operation.

In addition, the following measures should be put in force

- 1 Patients with respiratory infections, irrespective of their severity, should be excluded from the pre-operative ward

- 2 Hygiene of the upper respiratory passages should be insisted on as a preliminary to the operation

- 3 The anesthetist should be selected with the greatest care, and under no circumstances should an untrained individual administer ether without the closest supervision. Means should be taken to make the position of anesthetist one of honor

- 4 The duration of the narcosis should be as short as possible, the exposure of the patient should be minimized, under no circumstances should he be allowed to be in wet surroundings. Efficient organization can here be developed to a high degree.

- 5 As soon as the progress of the operation will permit the patient should be placed on his side to favor the drainage of throat and mouth secretions, and this position should be maintained until full consciousness is restored

- 6 On return to the ward the patient should be placed in warm blankets and should be watched by a special nurse until fully recovered from the effect of the anesthetic.

Postoperative pneumonia is a controllable disease. For its prevention and control close co-operation is needed between the surgical and medical service. It is the medical opportunity par excellence for a liaison officer

NEUROCIRCULATORY ASTHENIA

EPIDEMIC PAROTITIS AS A MILITARY DISEASE

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NEUROCIRCULATORY ASTHENIA

THERE are few if any of us who can fully comprehend how completely the war has altered all aspects of life in America. As we go on we become more and more convinced that the extent and degree to which the great war must change even the minor details of our life are but beginning to be realized. These modifications have been no less in medicine than in the manufacture of military as compared to sporting arms, and the constant wonder of those of us who have gone into the army hospitals from large civilian institutions has been the very different picture which the military type of a disease presents as compared to that with which we have been accustomed even in the largest of our civil hospitals.

I venture to say that two years ago few physicians, no matter how well read or how thoroughly conversant with their profession, would have recognized what the term "neurocirculatory asthenia" is meant to confer. Yet the disease has been long known in this country, dating back to the Civil War, when Da Costa described precisely the conditions which we are to discuss under the very apt caption of the "Irritable Heart of the Soldier." Our English colleagues who, unhappily for all of us, have been longer versed in the military medicine of this war denominate the syndrome, for it is really a collection of symptoms rather than a definite disease entity, as "D A H," which stands for disordered action of the heart. I find that Russian Army surgeons have long been familiar w

the condition, and it is very probable that we also should have remembered Da Costa's excellent description of the condition had we, as Russia, kept a standing army, but had we been thus forehanded it is very improbable that we should be at this time wearing a uniform and engaged in the most desperate combat of all history

We may briefly define neurocirculatory asthenia, which is the official term adopted by the Surgeon-General, as a complex of symptoms occurring with great frequency in males of the military age, characterized by neurocirculatory instability, chiefly manifested by marked emotionalism, cyanosed hands and feet, dermatographia and tachycardia, by tremor, and by attacks of asthenia, which simulate in aggravated instances epileptic attacks. More than anything else the cases resemble instances of hyperthyroidism which we see so frequently in young women. Indeed, many instances of neurocirculatory asthenia resemble exophthalmic goiter even to the extent of presenting, in addition to the other signs and symptoms, definite goiter and exophthalmus. We shall discuss later the probable relationship between these two conditions.

There are two distinct types of persons affected by this curious war disease, the one and the rather more numerous class is composed of young men of a high grade of intelligence, but of an intensely emotional temperament. The other class is composed of young men of a low grade of mentality, they are usually uneducated and incapable of acquiring knowledge and skill or anything, but none the less they are, like the other class, intensely emotional, neurasthenic, and not in the least stolid.

Why is it that we have all of a sudden become aware of the high degree of prevalence of this condition? There are several reasons. Many of these persons are quite able to grapple with the problems of ordinary civil life with its but moderate emotional strain and stress, though of an unstable nervous temperament. They have passed among their associates and friends, and even to their physician they have seemed but rather more than ordinarily temperamental. The nervous strain of war conditions, the breaking of home ties, the fear and anxiety of it all, and

finally, in many cases the emotional strain of the parting, perhaps associated more or less with excesses of an alcoholic and sexual character, have intensified the symptoms and rendered the condition apparent as a disease manifestation. More, however, than all of these factors combined has doubtless been the fact that in the course of the searching physical examination of the draft men we have found conditions which might pass without special comment in ordinary civil life. The great question for us to solve is: Are these men able to take up the vocation of a soldier, are they a credit or a debit to the military strength of the country? It is from this standpoint that I wish to discuss the subject. The disease is very common, more frequent than all other forms of circulatory diseases put together, as we meet them on recruiting boards.

One of the very first points which the recruiting officer will note in regard to these cases is the very strong influence which race plays in its incidence. The Jewish race includes fully two-thirds of the cases which present themselves, and of these, the greater number are among the Russian Jews. Next in point of frequency stand the Italians, then the Irish, the Americans, the Scandinavians, and last of all the negro.

As we have seen it, it is not common among the French, nor relatively so among the British. So very infrequent is the condition among the colored troops that I still seriously question the diagnosis in the three or four possible instances which I have observed in the very considerable number of colored men (nearly one division) which I have seen at Camp Upton.

Another very striking feature of the condition which we have all noted in our troops and draft men at Upton has been the very definite relation which heredity bears in neurocirculatory asthenia or "N C A.," as we shall call the condition. In by far the greater number of cases the taint has been transmitted from the maternal side, though by no means infrequently both parents, especially among the Russian Jews, have presented perfectly clear stigmata of the condition. In most cases these have been definite instances of hyperthyroidism, Graves' disease, or perhaps of myxedema, very frequently "epilepsy," neurasthenia

and almost without exception some form of nervous or emotional instability Major Goddard and Lieutenant Goldcamp have noted the very high degree of frequency with which parental or personal rachitis is associated in the disease I have wondered sometimes if this may not be in part due to the fact that the condition is very frequent among the Italians, who are also very prone to rickets

The early personal history of these cases is of very great importance and of great constancy in these cases In nearly all instances men afflicted with N C A give a history of unsound and sickly infancy, of the great care which was necessary in order to rear them Their early juvenile life has also been with few exceptions marked by all the ordinary and at least some of the extraordinary childhood illnesses and by frequent gastro-intestinal and metabolic disturbances

Few of them give a history of normal boyish physical exploits, and inquiry as to their sports almost always elicits some such answer as "I was not able to play baseball or football," "I was so poor at the games that the boys would not have me play with them," etc On the contrary, some of those of the intelligent class tell you that in youth they preferred to read, study, or some other sport not requiring physical effort, some of them early became interested in music or art to such a degree that they did not care for outdoor sports Still others make the statement that though they were fond of boyish games and sports, they had little opportunity to indulge in them because of shortness of breath, of palpitation of the heart, etc, when they tried to play Almost without exception they give thus the story of early physical inefficiency

Many of them state that the society of other boys was not agreeable to them, that they preferred to be by themselves, etc, "boys were too rough" In families one finds, as a rule, that the boys who develop this disorder selected the company of their sisters in preference to that of their brothers in their early years, and, as a rule, their pleasures and recreations of election were such as would entertain girls rather than boys

Notwithstanding this apparent preference for female society,

it is really astonishing to find how almost constantly these cases make the statement that the female sex has had little or no attraction for them, and by far over 50 per cent. of them have never experienced sex life with a female. Some state frankly that this has been because it has offered no attractions to them, others place their abstinence on moral grounds, others on inability, but most of all on disinclination. A few state that their experience in this direction was so unsatisfactory that it was not considered worth the effort, or that it caused them to feel worse, etc. It is believed that a certain considerable number are more or less perverted, but a majority are simply neutrals on sex matters.

In the choice of occupation a very similar tendency is shown. Few of these boys have elected occupations of an active character. Most of them have been clerks, accountants, students, writers, musicians, artists, and the like. A very few have attempted for a time such occupations as machinist, artisan, etc., but most state frankly that they found themselves inadequate for the work, that they either lost their jobs or threw them up for something of a more pacific character. A good many make the statement that their doctor forbade heavy work or exercise, and insisted on their selection of indoor or clerical work.

Nearly all of them give an extremely kaleidoscopic history of medical attendance and of diagnoses, in the larger number of instances they have been early told that they were suffering from "heart disease" and their instructions have been based on this assumption.

Most cases show a very poor physical development. The chest is narrow, the respiratory excursion constricted and limited, and as Goddard and Goldcamp have noted, a considerable number do show rachitic like deformities of the chest. As a rule the muscular development is poor, the muscle tissue flabby and immature. The beard growth is small, some show small or undescended testes, small penis, and a distribution of hair like that of the female type. This is, however, by no means constant, some of these subjects are perfect in these particulars, but the type as a whole is definitely and decidedly defective.

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Many of them state that the society of other boys was not agreeable to them, that they preferred to be by themselves, etc., "boys were too rough." In families one finds, as a rule, that the boys who develop this disorder selected the company of their sisters in preference to that of their brothers in their early years, and, as a rule, their pleasures and recreations of election were such as would entertain girls rather than boys.

Notwithstanding this apparent preference for female society,

it is really astonishing to find how almost constantly these cases make the statement that the female sex has had little or no attraction for them, and by far over 50 per cent. of them have never experienced sex life with a female. Some state frankly that this has been because it has offered no attractions to them, others place their abstinence on moral grounds, others on inability, but most of all on disinclination. A few state that their experience in this direction was so unsatisfactory that it was not considered worth the effort, or that it caused them to feel worse, etc. It is believed that a certain considerable number are more or less perverted, but a majority are simply neutrals on sex matters.

In the choice of occupation a very similar tendency is shown. Few of these boys have elected occupations of an active character. Most of them have been clerks, accountants, students, writers, musicians, artists, and the like. A very few have attempted for a time such occupations as machinist, artisan, etc., but most state frankly that they found themselves inadequate for the work, that they either lost their jobs or threw them up for something of a more pacific character. A good many make the statement that their doctor forbade heavy work or exercise, and insisted on their selection of indoor or clerical work.

Nearly all of them give an extremely kaleidoscopic history of medical attendance and of diagnoses, in the larger number of instances they have been early told that they were suffering from "heart disease" and their instructions have been based on this assumption.

Most cases show a very poor physical development. The chest is narrow, the respiratory excursion constricted and limited, and as Goddard and Goldcamp have noted, a considerable number do show rachitic like deformities of the chest. As a rule the muscular development is poor, the muscle tissue flabby and immature. The beard growth is small, some show small or undescended testes, small penis, and a distribution of hair like that of the female type. This is, however, by no means constant, some of these subjects are perfect in these particulars, but the type as a whole is definitely and decidedly defective.

I fancy that they are deficient in gonads as Barker would express it, they lack "pep" in the words of the top sergeant

The emotional and nervous status is the most striking feature of these cases. They are overly emotional, temperamental, imaginative, many of them are sent to the department of neurology and psychiatry instead of to the medical service. They weep, have hysterics, imitate most perfectly epileptic seizures, and otherwise act in a most artistic manner. Many of them are frightened to a pitiable degree at their induction into the army, and the prospect of actual combat terrorizes them almost beyond control. On the other hand, there are those of them who have sought the service with most elevated ideals of self sacrifice, who earnestly desire to imperil their lives and to offer them for their ideals. Some of these men are of the highest possible type from the standpoint of an idealist, almost too much so for real life, yet of such stuff are heroes made. On the contrary, others desert, beg for discharge, for exemption, for transfer to non-combatant corps, and all apparently with no sense of shame.

To one accustomed to these cases, as, for example, the recruiting officer soon learns to be, they may be picked out of the line almost unerringly, so clear-cut and definite is the clinical picture of the conditions. Some recruits especially when in terror or when perturbed, as during their physical examination, present the picture of a typical exophthalmic goiter. Exophthalmus with Von Grafe's and Stellwag's signs is present. The expression of the face is one of emotional distress and anxiety, goiter is definitely present, it may be bilateral, monolateral, or of the isthmus alone, and it, together with the exophthalmos, varies from time to time, always becoming more marked when under stress.

Tremor, especially marked in the hands, also present in the tongue, is a constant sign of the disease, it varies greatly in its intensity, but is always intensified by emotional disturbance. Curious to note, though the patients themselves note and complain of this symptom, few have found it to interfere with their occupation, as, for example, that of violinist, watchmaker, etc.,

in other words, under mental states the tremor is a controllable symptom to at least some degree

The evidences of neurocirculatory instability are numerous, the hands and feet are cyanosed, cold, and the palmar surface of the hands and axilla stream with sweat, even though the examining room be cold. Dermographia is very marked in nearly all instances, though it is a symptom again which varies much in degree, but is always intensified by emotional stress. Throbbing carotids, brachials, and so marked a throbbing of the abdominal aortas are occasionally seen that cases have been sent to my service under the diagnosis of abdominal aneurysm. One of these cases was in a very capable young physician who had himself confirmed the diagnosis, from which he was dissuaded with considerable difficulty.

But of all the signs and symptoms, that which is most constantly complained of and which serves to classify the cases is that of tachycardia. The heart rate may vary from 88 to 200 or even more, the action is tumultuous, and in a large number of cases where action is not so rapid as to completely prevent analysis a soft systolic murmur is frequently found, almost constant at the apex, but it varies much in intensity, quality, occurrence, and at times it entirely disappears. The murmur is not characteristically transmitted, it is certainly not due to any organic lesion, but a large number of these cases are diagnosed as instances of myocarditis, and still more often as mitral incompetence. In most cases there is no cardiac hypertrophy, this is a most important point to determine in the differentiation of these cases, for we shall find that in true N C A moderate exercise, especially if administered under congenial conditions, *slows the heart*, and if persistently and intelligently so applied, permanent slowing may follow. Most of the cases complain of more or less cardiac distress, of a sense of precordial pressure, of a bursting pain behind the sternum, sometimes of lancinating pains reflected into the axilla, etc. The description is commonly not very consistent or coherent, but they all complain of some sort of symptoms in this region. Head zones of cardiac hyperesthesia are, however, not ordinarily present, and careful

study of the heart under varying loads by the fluoroscope and polygraph show no evidences of organic cardiac disease. In the latter stages, just as in true exophthalmic goiter, of course finally cardiac disease does develop, but it is commonly not evident during the military ages, but only long after

Dyspnea is present almost invariably, it is definitely excited more by mental rather than physical conditions, and while in carefully graduated cases dyspnea diminishes much, it can be easily aroused by mental stimulation. One of our cases would develop dyspnea of the most distressing degree if told that he was a slacker trying to evade service. Some other cases, however, fail to object to this remark. It is true that in most cases the chest is poorly developed and that the aëration of the blood is habitually defective in most of these cases. But it is also quite certain that be this as it may, there is no connection between the anatomy of the lung and this frequent sign of dyspnea.

The asthenic attacks are, however, among the most interesting and difficult of explanation. Some cases show them only in a very mild degree and others in a very marked grade. Some attacks are clearly of a hysteric type, they may be excited by fright, temper, and sometimes I think that they may be conjured up by the earnest desire of a peacefully inclined slacker. In other instances they are convulsive in nature like an attack of epilepsy, the tongue may be bitten in the paroxysm, and the patient may lie for hours thereafter in a comatose state. The attacks are very likely to appear in the course of an unaccustomed hike, especially with the recruit who becomes convinced that he is asked to do more than he is liable or able to perform.

Our patients tell me that these attacks have come on entirely without warning, and the patient was only aware of the syncope when he awakened in the hospital. I do not believe that many of these attacks can be distinguished from true epileptic paroxysms in single instances, and the absolute differentiation implies often a long and discerning study of a case. Occasionally in place of a convulsive paroxysm the patient flies into an ungovernable and incoherent attack of temper, during which he

is really irresponsible, or he may weep and carry on like a hysterical young lady. Although many of these attacks are brought on during physical exercise and particularly during unaccustomedly heavy drill, it is notable that the most frequent exciting cause has an emotional basis. I recall one instance in which a sharp word of reproof from a general to a recruit who had failed to salute him properly caused the poor chap to fall in a convulsion at the very feet of majesty, who was then almost as much perturbed as the poor soldier himself.

Where these cases may be placed under careful and skilled medical care, and especially when the young soldier becomes more accustomed and reconciled to his new life, it is notable that in nearly all cases improvement occurs. In one class of cases, however, this is not the case—that is, in those which are definite instances of exophthalmic goiter, these I believe without exception fail to show improvement even though they may become more adjusted to their environment.

One can hardly see these cases and not feel at the very outset that in some way they are dependent on some lack or irregular or deficient action of the chromaffin system, particularly of the adrenals or thyroid. Close study has, however, convinced me that it is not by any means purely a question of hyperthyroidism, though I am also convinced that hyperthyroidism plays an important rôle in the syndrome. The administration of thyroid to these cases accentuates beyond any doubt the symptoms, similarly, the giving of adrenalin intensifies the symptoms. Blood-pressure in the disease is almost always low and the pulse-pressure notably so, yet the subcutaneous administration of adrenalin fails to raise it. We shall presently return to this phase of the question, however, in the discussion of the etiology.

Tobacco intensifies the symptoms, especially if used in excess. Most patients fully recognize this fact, and frankly state that they are so much worse when they use tobacco, especially liberally, that they find themselves obliged to give it up entirely. Few of these patients use tobacco where the condition is fully developed. The same is true of alcohol. The patients soon

find that they cannot tolerate alcohol with comfort, and the effects are soon such that they develop a distaste for all forms of alcohol. For the same reason few of these recruits are devoted to the theater or to the reading of detective stories, they have found that all emotional stimulants cause an exaggeration of their symptoms and an increase of their discomfort.

As I have described this syndrome to you, it must be evident that I am picturing to you a hereditary condition to a greater or lesser degree, a picture which is dependent in very large part at least on very early defects in the emotional mechanism of a man and evident in his very early youth. The full-bloom complex is developed by emotional excitement incident to his draft, his separation from home, and the new and rather terrifying occupation and life into which he is suddenly projected, often more or less unwillingly. Our question is, Can we make soldiers of this material? And second, If not full line duty soldiers, then can we still utilize them for semimilitary purposes in clerkships, in factories, or on farms? This is the N C A which we see in the concentration camp and in the training-school, for this is a very frequent condition in the training-schools for young officers particularly. The British report a condition with a similar clinical cast, but which develops under condition of actual service and especially in troops after protracted trench duty. Lewis, Mackenzie, and others connected with the great cardiac hospitals in Great Britain picture this condition as developing as a result of hard service, and show, of course, its very intimate relationship to that still more indefinite war-medical problem—shell shock. Fully 20 per cent of such cases under appropriate treatment are able to be returned to full line duty. This has not been our good fortune, and Rothschild, of Mt Sinai Hospital, who with Oppenheimer has made an extensive study of this condition in the British hospitals, confirms our suspicion that the cases which occur under service stress are a quite different and altogether a more promising problem than those which develop under the lesser stress such as we have studied in the mobilization and training camps, where none the less the condition has been astoundingly

frequent—certainly thousands of cases have been observed in our camp at Upton alone

To return now to the etiology I do not believe that anyone can study these cases, at least those which have fallen to my service, without being at first strongly of the opinion that the condition is purely one of hyperthyroidism. There is no sign or symptom in N C A. which may not be caused by hyperthyroidism nor which is not observed at least in analogy in young women afflicted with Graves' disease. On the other hand, a more careful and prolonged study has shown me that this assumption is not satisfactory. Many cases show no goiter, but, of course, we all recognize that hyperthyroid secretion may easily occur without demonstrable goiter, but in this disease the predominance of the asthenic symptoms is so much greater than in simple Graves' disease that when they are well marked and the other evidences of hyperthyroidism wanting, and especially if it be found, as is frequently the case, that emotional states *only* cause the onset of the symptoms, one must be convinced that the real condition is something definitely more obscure than hyperthyroidism.

This conviction is further emphasized by the very frequent development of precisely this condition after the grave infections, and it has been the study particularly of these cases that has won me over to the conception that we are really dealing with something above and added on to hyperthyroidism in this syndrome.

The condition has frequently developed in my wards during the convalescence from pneumonia, from epidemic cerebrospinal meningitis, after rheumatic fever, and the like. It is impossible for me purely from the clinical picture to distinguish these cases from those which enter the service with the already developed N C A. Those postinfectious cases, however, unquestionably do far better as to ultimate result than the spontaneous or hereditary ones. Doubtless in the postinfectious cases also there is a certain degree of myocardial disease associated with the tachycardia, and it will never do to subject these soldiers to the same physical drill and stress as that on

which the congenital cases customarily thrive Time alone effects a cure in the postinfectious group in a very large number of cases I greatly question if time will produce this result in the more common congenital case What is the place in this picture then of those cases which develop in the course of military effort? For the proper interpretation of these cases we must turn beyond doubt at this time to the experience of our British colleagues, for they have very extensively studied this aspect of the syndrome, doubtless precisely their problem will shortly be presented to us when we begin to have our sick return from the battle-fields

Psychic rest and carefully graduated physical exercises, beginning with very light work, in the nature, of course, of drill, and leading on up to long hikes under the full weight pack and equipment, have so improved these cases that they have been able to return full 20 per cent to line duty, a still larger percentage to light and domestic duties, and practically all to some sort of duty of use to the government.

We have for some months at Camp Upton attempted to carry out these ideas in our cardiovascular service, our cases being practically all of the congenital or hereditary type One notes almost immediately that the cases when given drill or police work divide themselves automatically into two classes—those in which the heart rate is diminished by the exercise and those whose response to effort is poor The first class of cases, which comprises by far the larger group, is much improved by this training with which is associated a certain amount of mental discipline, for these patients are told, and in my opinion quite truthfully, that they have no heart disease and that their condition is one which is curable and which is unquestionably benefited by work and drill Those cases which fail to respond to the drill, that is, those which have persistently an increase instead of a diminished heart rate under exercise, are discharged from the service as soon as it can be brought about.

Favorable cases after their discharge from the hospital where we have so far as possible isolated these cases from all others, exacting from them a more strict compliance with military

discipline and customs, are sent to a Development Battalion in the main camp, where these men are theoretically given lighter military duty and training, theoretically under the close supervision of medical officers. The theory is good, but the actual working out of this plan has not thus far been satisfactory because of the lack of proper medical control of these men. The "regular" cannot believe but that all of these men are members of the genus malingerer, and at least in our camp the system has not had as fair a trial as has been given it in Great Britain, where apparently soldier material is more carefully conserved than is yet the case with us.

The experiment has, however, gone quite far enough to satisfy me that with these congenital cases a sufficiently complete restitution to normal status, so that full military duty is to be exacted, is not to be expected from this type of case.

Naturally the physician at once questions what of other methods of treatment, what of digitalis, of electric treatment, hydrotherapy, etc.? I confess that all of these methods have not received a fair trial at our hospital, but enough so to convince me as a medical officer, not as a medical man pure and simple, that my time in this direction is wasted. If we cannot restore these men to a real military status within a reasonable length of time and at a reasonable cost it is far better, in my opinion, to return them to civil life where many of them may carry on in a pretty satisfactory way, in the army their constant complaints and their military ineffectiveness causes them to be not an assistance, but a definite nuisance.

Rest in bed without exception causes these cases to become much worse. Management as though a cardiac case, that is, with greatly restricted exercise, etc., causes them to become worse, particularly in their emotional aberrations. Digitalis fails to slow the heart unless given in very large doses, and even then the heart efficiency in so far as may be judged by the exercise response is decreased rather than increased. The same is, of course, true of strophanthus. Caffein, strychnin, camphor, adrenalin, small doses of thyroid all definitely accentuate the symptoms of the disease. Bromids improve temporarily in

most cases, but, of course, their effect is not lasting and it cannot be considered as in any way a curative method. In my opinion there are no medical measures which are of benefit in these cases. The most successful treatment is, beyond doubt, psychic and physical training.

I have, as you note, not spoken in a very optimistic way in regard to even those cases which respond well to the physical training, that is, in so far as adaptation for military duty is concerned, but I am convinced none the less that a considerable number of these cases thus managed for a long period of time may be greatly improved, but I doubt if sufficiently so, so that they may be sent with wisdom and complete safety to full line duty, and I question very much the real economic value when the time and effort of the officers are considered from an economic basis as compared to the amount and character of military material thus saved.

Many, very many of these cases, however, are quite capable of undertaking other than line duty with perfect results. Some of our best clerks, paper men, ward masters, telegraphers, telephone men, quartermaster men, and even medical officers may be selected from this material. Bandsmen, kitchen workers, and many other places of necessary but not strictly military importance and work can be satisfactorily filled from this material. I very much regret that as yet no satisfactory method exists by means of which medical officers may thus select from this oftentimes valuable material men eminently valuable for these, but probably never available for real soldier duty.

As a physician I am very much interested in the effect which this method of training would probably have on these cases—could they be selected or discovered in early youth. I am much of the opinion that if they could be put under treatment of a developmental character in early youth most of them would be entirely cured.

Now as to those cases which have developed as a result of or at least after the infectious diseases. Practically the same method of treatment is doubtless the best, but here much more discretion must be exercised and a most competent and con-

stant medical supervision is necessary, for in very many of these cases myocardial disease, either degenerative or inflammatory, is certainly present in greater or lesser degree. These cases cannot be thrown in with the congenital N. C. A. cases, though in every particular they resemble them except in the very important manner of origin. Here the intelligent use of digitals, of bromids, of iron, of a carefully studied and supervised diet is all important. These cases must be physically trained, but in my opinion, which differs, it is true, from that of the greater experienced British officers, they must be considered as potential cases of organic disease and handled in precisely this manner. I know that in civil life I never realized so fully as now the absolute necessity for graduated physical drill in these cases. In my opinion it is far more necessary than any other one method, but it is not all, and the medical officer in his management of these cases must never forget that he is also a physician.

As for those cases to which we have occasionally referred in this informal talk, those which from the very outset show the definite picture of hyperthyroidism, though some of them may be improved as a result of the physical training, none of them, in my opinion, improve more than slightly, some of them are definitely made worse, they are utterly worthless as military material, not physically or mentally valuable in my opinion in any part of the military machine.

I have been asked definitely to say just what I think should be done with cases of this type from a military standpoint. I am glad of the opportunity. I would discharge absolutely all those cases which after a relatively brief period of observation seem to fall into the definitely hyperthyroid group. From the very large number of congenital cases I would select such as under a brief period of observation show themselves to respond fairly well to the physical tests and whose mentality or occupations are such as may be profitably utilized in the military mechanism. I would expect to find no congenital cases capable of undertaking full military line duty. These men should be placed in a development battalion where they may receive a sufficient amount of military training to fit them not for military

work, but to perform in a military way those special duties for which their mentality or training fits them

The group of cases appearing after the infections should be most carefully selected and trained under an experienced cardiologist or medical officer with the aid of intelligent and considerate non-commissioned officers, but they must be considered as patients as well as men under modified military training. A large percentage of these men should be returned to full military duty, but if carelessly or inefficiently managed most of them will inevitably break or become a care instead of an asset to the nation at war

EPIDEMIC PAROTITIS AS A MILITARY DISEASE

In the mind of the ordinary civil practitioner mumps is a disease of little importance. Its care in the large cities is chiefly in the hands of the pediatricist or general practitioner, and the usual attitude of the physician toward the disease is that it is a somewhat disagreeable condition of little economic or medical interest. Its occurrence in the adult is looked upon as rather unusual, and by most persons, except the patient himself, it is considered as something of a joke of a decidedly juvenile character.

The military medical man has, however, a definitely different attitude toward the disease. It is very frequent in the men of military age, that is, between twenty-one and thirty-one, and in the soldier it is known as one of the most frequent, most highly contagious and unmanageable of contagions. It is also one of the most difficult of the infections to trace or eradicate even among seasoned troops once that it gains a footing. The mortality rate is occasionally relatively high in encampments, but its chief factor of military importance is an economic one. Epidemic parotitis quite as thoroughly disqualifies a soldier for duty as may a shell wound or a fractured extremity. Epidemic parotitis may put a company, a battalion, a regiment, or even a brigade temporarily quite as thoroughly out of action as typhoid fever or cholera. Such being the case, an entire mili-

tary project may fail as a result of this apparently insignificant disease.

Measured in loss of time, in cost of maintenance, and from every military standpoint except that of burial and pension costs to the nation, mumps may be at times as important as scarlet fever or German rifle fire.

At Camp Upton alone during the time since the Base Hospital has been established, from September 5, 1917, to this date, July 12, 1918, 1059 cases of mumps have been under our care at this institution. At Upton 80 per cent. of these cases averaged sixteen days in the hospital, 15 per cent., twenty-one days, 5 per cent. remained four weeks or longer. Thus this apparently trivial disease as it has occurred at Camp Upton alone has cost the government approximately 18,520 days of service. In the comparatively small factor of pay alone, assuming that every sufferer from the disease was but of the rank of private, and this is by no means the case, it has cost the government \$18,520, and when we add to this the cost of ration, about 45 cents per man daily, amounting to the neat little sum of \$8335, the pay of officers, men, and nurses in necessary attendance upon the sick, the drugs, bed-linen, the housing, and transportation you can readily see that quite aside from the loss of military service in the crucially necessary time of training, mumps has been in this single cantonment of very considerable economic importance even to the United States of America. This is partly my excuse for presenting this problem to you.

There is another side of the question which will, I think, appeal to you with equal or even greater force. As we have compared our ordinary text-book account of this disease to the picture which has been unfolded in our wards we have been struck with the altogether inadequate theoretic presentation of the disease, and with the fact that each author seems to have very largely copied from another instead of backing his description from a wide clinical experience of his own. A very large number of important questions in regard to mumps which still remain unanswered exist in almost every phase of the

disease To the candid student we have apparently added but little to the picture of the disease as given by Hippocrates, who defined it as a disease of children and young male adults, noting the involvement of the salivary glands, the absence of suppuration, and the frequency of orchitis Even Hippocrates notes its decided preference for the male, and in our little hospital of but 2000 beds only 3 out of our list of 300 female nurses of approximately similar ages developed the disease, and thus it is classed at once as a disease of the male And of these nurses, one was a dietitian and neither of the other two had, to our knowledge, any close communication with the mumps cases We have not been so fortunate with the enlisted men, but with that strange protection with which the careless medico is invested, none of us have contracted the infection

As with practically all the acute infections, mumps has appeared most frequently among rural rather than urban troops. Our percentage has been 85 per cent rural and 15 per cent urban As is also generally known, it has in most instances attacked nearly all the exposed soldiers not immunized by previous attacks, but in nearly 50 per cent of the instances affected a history of previous attacks of mumps has been given While in many, very many instances this is due doubtless to mistaken diagnosis on the part of the patient, there can be no doubt whatever but that one attack of the mumps does not permanently immunize One case in particular occurs to me A young soldier came to our service with a typical parotitis involving one side, in the course of which an orchitis of the corresponding testicle developed On the conclusion of the case he was sent to duty, but he returned to the same ward three weeks later with a typical picture of epidemic parotitis on the opposite side, which was again followed by a complicating orchitis My observations in this epidemic has convinced me that to a considerable extent mumps is a localized disease—that is, it rarely recurs in the same gland twice—and there is much to commend the old lady's idea that the prognosis as to duration of the case is better when practically all of the usual glands are involved early in the disease, otherwise as one parotid

or submaxillary subsides an infection of the glands on the other side develops. This prolongs the case very materially and there is, to my mind, much to commend the idea that the disease is a localized infection and not a hemic or lymphatic disease.

A problem which has much occupied our interest has been as to the manner of inoculation. Of course from analogy it is very simple to assume that it is transmitted through the respiratory tract or that it is a buccal inoculation. Certain experiments with which I am acquainted, however, have failed to show infection by these avenues when it was attempted voluntarily, and even where the saliva expressed from an infected gland has been applied to the duct papilla of a person supposed to have never had the disease. The infection has not followed repeated inoculations in this manner. There is, however, no evidence but that our supposed test case may not have had at some time in the past an unrecognized mumps, or that he may not have had a natural immunity against the disease.

Cross infection where respiratory and buccal infection may well have been the avenue has been possible in very many clinical instances. That at times there exists at least temporary immunity against the infection seems to be undoubted, for cases frequently directly exposed to patients with the disease and yet failing to develop it have subsequently succumbed to what must have been a very slight exposure, sometimes merely a passing contact. This fact has been particularly illustrated in several of our ward men, who perhaps had left the service in the mumps ward, when after a considerable time they finally developed the infection apparently from some very transient exposure.

We have made an attempt to determine as accurately as may be as to the incubation period of a mumps infection. This we have certainly not been able to do, but in so far as we may surmise it is extremely variable. Some infections have apparently developed as soon as five days after exposure, others have gone as long (in one instance) probably as sixteen days, but in so far as we can surmise the average has been about ten or twelve days. We do not believe that the disease is con

veyed other than by contact, that is, from person to person. I do not feel that it is conveyed by fomites at all. We have observed no recrudescences of the infection in organizations indicating an infection appearing as long as twenty-one days after the exposure, as Osler states to be possible. And I am of the opinion that if developing so long after a single exposure, infection by some intermediary agent must be considered.

As to the time during which a case remains infectious we cannot state specifically, but I am of the opinion that the disease may be transmitted as long as the active lesions—that is, the swollen glands—persist.

We have nothing new to offer as to the etiologic factor which primarily causes mumps. Much in the clinical picture of the disease as it has appeared to us indicates that it is not a general hemic infection, but one of the more or less accessible glands, for we have been unable to demonstrate the involvement of pancreas as one would certainly expect were the disease a hemic infection, since it shows so definite a proclivity for the racemose glands. The old suggestion that the disease is conveyed to the testicle by hand urethral inoculation has something to support it, but this theory does not explain those occasional cases, some 4 or 5 of which have been seen in this epidemic, in which orchitis preceded any demonstrable involvement of the salivary glands. It was intended to attempt to substantiate the well-known work of Martha Wollstein, but owing to the fact that our epidemic of pneumonia, which since it brought about the death of so many soldiers demanded our chief interest for the time being, this investigation was abandoned.

Most of our cases developed in troops brought to Camp Upton in divisions arriving from widely distant points, the number of cases developing in our own local division, the 77th, was very small, hence it would seem that there can be no question that a single strain of the infecting agent was alone concerned in the group of cases which I have been studying. Four distinct outbreaks of the disease, all originating from infections developed far from New York, have appeared in the same number of divisions which have mobilized at this camp. Colored

men have appeared to be the more susceptible to the disease than white soldiers (93 per cent.), and so also too they appear to me more liable to the reinfections than whites, if we may put sufficient dependence on the correctness of the former diagnoses.

There has been nothing striking in the manner of onset. In most cases no prodromal symptoms whatever have been present, and the first observation of the patient or of his comrades has been the swollen glands. Many cases during this stage present no more than a slight increase of temperature, 99° to 101° F, but a few exceptional cases have shown an onset with prostration and a high fever. Onset with chill is very unusual. As a rule, the temperature falls within forty-eight hours and remains down unless another gland becomes infected, when again a slight rise in temperature with a proportionate quickening of the pulse-rate appears. Orchitis is almost invariably accompanied by a much more marked rise in temperature, but, curiously, the pulse-rate has in most cases not proportionately increased, but has remained at a notably low rate.

The parotid gland has, of course, been the one most frequently involved and first affected, the submaxillary next, and last the sublingual. Not a single case of the involvement of the lacrymal glands has appeared in our large group of cases. There appears to be no regular order by which the various glands become involved secondarily, that is, one may have the parotid on one side and the submaxillary on the other, with perhaps the secondary invasion of the opposite parotid, submaxillary, and sublingual—again suggesting that the disease is not a hemic one. The more common occurrence of the successive invasion of the various salivary glands instead of their occasionally seen spontaneous invasion would also suggest the same assumption.

One of the most interesting observations which we have made has been as to the occurrence or absence of salivation. In most cases there has been but little alteration in the quantity of salivary secretion in so far as we could determine. In another group of cases, however, there has been marked salivation, and in still another considerable group the patients complained

of lack of sufficient saliva, and inspection of the buccal mucous membranes has shown a puckered, desiccated, and wrinkled appearance with markedly insufficient salivary secretion. My observation of this hyper- or hyposalivary secretion has borne no direct observable relationship to the glands or number of glands involved at that time. The old familiar household test of the taking of some acid substance—an acid fruit or pickle—has been valueless as a diagnostic means in the disease, some patients crave greatly the acids and others do find difficulty and pain in partaking of them.

Pain in the region of the involved glands is, in my experience, more due to the mechanical condition than to any other factor. When the swelling of the glands is great, as the result apparently of the mechanical pressure upon the nerve trunks, considerable pain may be experienced, especially upon movement of the lower jaw.

Microscopic examination of the salivary secretions has shown no apparent typical condition present. Doubtless there are certain chemical alterations, but our time and facilities have not permitted us to investigate this point, nor have we been able to study the buccal secretions for the specific cause of the disease, chiefly for the reason that our time for the work of this character has been limited by the insistent clinical demands of our very heavy service at the Base Hospital.

One does usually note that the papilla is edematous, swollen, and inflamed, but, in my opinion, not to a diagnostic degree. The duration of the swelling in any gland has been extremely variable, and has at times subsided very rapidly, again it has persisted in greater or lesser degree for several weeks. One may perhaps state with Osler that as an average about seven days' time passes before the swelling in a definitely enlarged gland has completely subsided.

As we have previously stated, the duration of the disease seems chiefly dependent upon whether all glands are involved at once, or whether the involvement of glands occurs slowly, which always greatly increases the length of disease.

The degree of prostration at the onset of the infection is

often very severe, it appears, however, to be in nowise dependent on the extent of the swelling or on the number of the salivary glands involved. One oftentimes finds tremendous swelling of the glands with few general symptoms and but little discomfort, and that apparently mechanical in origin.

Greatly prostrated cases are likely to develop mania, oftentimes a wild delirium, or the patient may subside into a comatose state simulating a uremia. Meningismus has not been a frequent symptom-complex in this epidemic, but three instances developed in our group, and none of them so marked as I have previously seen in civil practice. The disease, in so far as the clinical symptoms are concerned, has appeared to me no more severe in these soldiers than I have seen in children in civil work, nor has it seemed less severe. I refer now entirely to cases without the complication of orchitis.

In cases showing meningismus a certain degree of stiffness of the neck may be manifest. Care must be taken, however, not to confuse this with the natural stiffness of the neck which mechanically follows the swelling and turgescence of the parotids. A Babinski reflex may be present. If so, it is commonly inconstant, and some cases show an accentuated knee-jerk or unequal ones. In the three instances which have shown these symptoms in our group of soldiers no alterations have been found in the cerebrospinal fluid as removed by lumbar tap. None of our cases develop a true meningitis, as is sometimes reported, and as I have myself occasionally seen.

Ordinarily relapses during the course of the disease are not observed. This does not, however, refer to the very frequent prolongation of the disease by the involvement of other glands. This is, as I think you have all gathered from previous remarks, very common, and in our experience it is by far the wiser plan to confine all cases strictly to bed and to the ward rather than to the porches during all the active stages of the disease. If patients are allowed up too soon and especially if they are permitted to go about and out-of-doors, in our opinion a recurrence of the disease is to be expected.

I have previously mentioned one striking recurrence of the

infection occurring three weeks after apparent cure of the disease, very many cases have numbered the present attack as the second, third, or very rarely the fourth one of the disease. In our belief, immunity is more a matter of immunity of previously involved glands rather than of a general or systemic condition

Complications in mumps as we have seen them have not been very diversified, but they have been very frequent, 24 per cent. have shown the most frequent complication, that is, orchitis. Just as with the involvement of the salivary glands, the degree of the swelling does not appear to be a measure of the severity of the systemic symptoms, but, of course, the degree of inconvenience and the severity of the pain is largely dependent upon the size of the involved testis. I have had my old conviction confirmed, viz, that traumatism of the testicles predisposes to the occurrence of orchitis, and I am convinced that injudicious palpation of a questionably enlarged testis may excite or determine an orchitis, and I am further convinced that even slight injuries to the organ when once involved may cause it to extend. I have learned to respect the patient's feelings in this matter very largely. Patients who have suffered a previous orchitis are almost certain to have involvement of the testicles in this disease. To us a new feature in the orchitis of mumps has been presented in the great frequency with which we have seen an epididymitis, either preceding, accompanying, or complicating the orchitis. In some few instances it has appeared independently of an orchitis, but usually associated with it. This frequency of epididymitis is not in accord with the usual text-book description of mumps, which has, of course, been chiefly based on the study of the disease in youths, often before puberty. It has not been accompanied by inguinal enlargement in most cases, but where it has developed (as has not infrequently been the case in cases suffering from a gonorrheal urethritis) it has been so found, and usually has been very severe.

As we have previously indicated, the orchitis may be the initial evidence of the disease, and not a few cases have been first referred to the venereal services because of this fact, and

have subsequently developed the salivary enlargement, etc., and fully complied with the diagnostic requirements of the infection

It has occurred to us that it is quite possible that the frequency of occurrence of epididymitis with our cases may be associated with previous epididymitis due to old gonorrhea. This assumption is in part born out by the almost universal occurrence of both epididymitis and orchitis in cases which develop in the course of a gonorrheal urethritis. The high frequency of a history of a previous gonorrhea in many of our patients, which have been so largely among our colored troops (93 per cent.), a very high percentage of whom have or have had a recent gonorrhea may have a direct bearing on this complication

With the development of an orchitis there is always a marked increase in temperature, oftentimes as much as 105° or 106° F, and occasionally with a chill. Temperature persists until the degree of the inflammation begins to subside. It is strikingly often seen that the rise in temperature is not accompanied by a corresponding increase in the pulse rate, and in none of the cases has there been an increase in the polymorphonuclear leukocytes. While we are mentioning this fact it is interesting to note that as we have seen this infection the blood picture is little or not at all changed either in simple or complicated cases, though occasionally there is a relative increase in the mononuclear leukocytes.

None of our cases of orchitis or epididymitis, even in cases complicated by acute gonorrhea, have developed pus formations in either epididymitis or testis, nor, for that matter, in the salivary glands, even though a urethritis, commonly with a sterile exudate, may appear. Atrophy of the testis is mentioned in some accounts of the disease as being a frequent sequence. It is not entirely possible to state definitely as to this in our cases, most of which have not remained under observation over from two to four weeks, but in two definite instances an apparent interstitial orchitis has developed which was apparently leading on to testicular atrophy when the cases were discharged to duty. Of course our control of our material has not permitted us to

make any observations on subsequent fertility. In 95 per cent of our cases the orchitis or the epididymitis has been bilateral.

Under other complications mastitis has occurred twice. Otitis media has been seen several times, but only in cases giving a previous history of otitis media chronica or where the nasal or throat condition was such that this frequent condition might be expected to occur spontaneously and independently of the mumps, to which we believe it bears a casual relation. Thyroid goiter has been seen several times, especially where the parotitis was bilateral and marked. I believe it to have been mechanical rather than metastatic in origin. In 3 cases symptoms indicative of a possible pancreatitis have been observed, nothing very definitely conclusive of it, however, and a close study of this large group of cases with special inquiry as to this complication has been negative except for these possible instances.

Tonsillitis has been seen quite frequently, and in these instances and these only cervical adenitis has been present. Most of the cases have shown a streptococcus tonsillitis, and the occurrence of this complication is believed to bear no direct or important relationship to the specific infection. It is evidently incidental, perhaps favored by the more or less uncleanly condition of the buccal cavity, which may well be a secondary result of the disease.

Pneumonia has been quite frequent in our mumps wards, as it has been frequent in every department of the hospital. Part of the cases have been due to the pneumococcus of various types, but, as has been the case with our pneumonia epidemic outside these wards, streptococcus infections have predominated. Our only fatalities in mumps have been in those cases complicated by pneumonia, and in so far as we can judge the pneumonia borne no more relationship to the mumps than it has to gastro-intestinal disorders, or any other large group of disease conditions with which we have had to deal.

No cases of very severe prostration, of hemiplegia, or of true meningitis have appeared in our series, and no cases of insanity have developed, though in several instances mumps has developed in cases of mental alienation. Arthritis has not been

seen except as it has developed apparently spontaneously, and when it has subsided under the use of the salicylates. Blood-cultures which have been extensively employed in all serious cases have been universally sterile. Albuminuria of a transitory character has been very frequent during the febrile periods of the disease, but in all instances it has cleared up and no true nephritis has been seen, although in many cases hyaline casts and occasional granular ones have been found in greater or lesser numbers. Neuritis has not been seen.

Epidemic parotitis as it has occurred in this camp has been a serious economic and military problem, it has cost the government much money and much time, it has necessitated the enlargement of our hospital, the increase of our staff, but it has figured only as a very negligible factor in our mortality lists even when it was complicated with other disease conditions. It has, however, lost us much valuable time in the training of our soldiers, it has obligated rigid quarantine measures, detention camps, and other very necessary restrictions of an irksome character from the military standpoint, but it has probably been a factor of almost no importance in so far as total disability for military service is concerned.

In so far as treatment is concerned we have immediately isolated recognized cases, and in a few instances we have isolated for a period of fourteen days soldiers in immediate contact with cases, but in our experience this is not a necessary or an advisable procedure from a military standpoint unless it is possible to at the same time continue the military training of the exposed men. Where this is possible no objection to the plan can exist, but from our experience, supplemented by the common judgment of military medical men of wide field experience, the soldier not immune to this disease will sooner or later contract it, irrespective of such restrictions as we may lay down. (11)

We believe that it is very important to immediately place all sufferers from this disease in bed and to keep them there at least until the active stages of the disease have passed away. By this simple and inexpensive procedure we believe that many of the serious complications of the disease may be avoided.

and the severity of the infection and the duration of it considerably mitigated. We believe that confinement to bed and in warm and comfortable wards minimizes and limits involvement of the testis and greatly lessens the liability to relapse and recurrence.

We have universally opened the bowels by a brisk saline purge and kept the patients on a light fluid diet just so long as a temperature has been present, and on a low diet until they were able to be transferred to the convalescent wards, where they were required to do light drill, ward and kitchen police until after a period of easy soldier work they were able to return to full military duty. We have separated the patients by inter-bed screens in an attempt to minimize secondary infections, especially from streptococci and pneumococci, and we have treated each case symptomatically and as an individual.

In some cases heat has been applied to the enlarged glands, in other instances cold in the form of the ice-bag, but in most cases no local treatment has been applied, and where it has seemed to have been indicated the form has been largely determined by the symptomatic comfort which the patient experienced. The buccal cavity in all and the nasal cavities in many cases have been systematically cleansed by mild alkaline gargles and sprays, so as to minimize the infection of the adjacent spaces.

Great care has been exerted to prevent even slight traumatism of the testicles, and where an orchitis or epididymitis has developed the "Bellevue bridge" was universally employed, and here again heat or cold in the form of hot water or ice-bag, as seemed to give the patient most relief.

The important data still to be derived from a study of mumps as a military disease seems to be, first, the discovery of a means if possible by which immunity against the infection may be determined. Second, to discover the avenue of infection so that the spread of the disease may be limited. Third, to determine the incubation period. Our present studies in this epidemic are along these lines, but nothing definite has as yet been established on either of these phases of the condition.

Finally, of course the most important and elemental question from all aspects is the discovery and identification of the etiologic factor of the disease. Work along these lines has as yet given us nothing of sufficient surety to admit of clinical application at least, although definite progress in this inquiry has been made by several investigators and especially by Martha Wollstein. A great opportunity for broad studies of this nature is presented in nearly all of our great military hospitals at this time, but we must look to others than those burdened with the insistent clinical and military problems of the regular staff of our great hospitals for this help. The opportunity and the need is great, but workers capable of such a research are few

THE BASAL METABOLISM IN CASES OF THE "IRRITABLE HEART OF SOLDIERS"

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AMONG the many complex problems which have recently attracted the attention of internists none has proved to be more baffling than the determination of the factors underlying the condition generally known as the "irritable heart of soldiers." Many names have been suggested as substitutes for that originally used by DaCosta, and much speculation has been indulged in as to the etiology of the symptom-complex, but comparatively few scientific studies have been made with a view to bringing out accurate facts. It is only by the correlation of careful observations, tested point by point by the most reliable methods on considerable numbers of cases, that one may reasonably expect to bring order out of what is now a clinical chaos.

At the present time, in the United States at least, the patients referred to the cardiac services of military hospitals for "irritable heart" or "functional heart disease" certainly do not represent one single clinical entity. The opportunity for more intensive study than is possible in most camps reveals that in many there is a definite organic basis for their symptoms, such as tuberculosis, myocarditis, valvular heart disease, outspoken hyperthyroidism, or neurologic disease. Even the remainder, in whom no evidence of organic lesion is to be found to account for the symptoms—the true instances of "irritable heart"—give rather varying clinical pictures, and it is quite probable that they represent several clinical conditions. Many of these cases resemble so closely what is known as the "forme fruste" of Graves' disease that the diagnosis of hyperthyroidism is frequently made, and, indeed, not a few physicians consider that

most cases of "functional heart disease" are due to overactivity of the thyroid gland. In view of this fact it was considered important that the relation of the thyroid gland to the symptom-complex of "irritable heart" should be investigated at General Hospital No 9, at which institution special facilities have been provided for the study of these cases. The present paper deals with the results of the study of the basal metabolism in 59 cases.

METHOD

It is generally recognized that the most characteristic result of hyperactivity of the thyroid gland is the production of a rise in basal metabolism, and, indeed, observations on large numbers of patients in various hospitals have shown quite definitely that the severity of the clinical symptoms of hyperthyroidism runs closely parallel to the degree to which the metabolism is raised above the normal. The determination of the basal metabolism or of the heat production gives, therefore, at the present time the most accurate basis for deciding whether or not the thyroid gland is abnormally active. The methods used in the present investigation are standard ones and need not be described in detail. All determinations were made in the morning on patients who had fasted since the previous evening. After lying at rest in the laboratory until the pulse-rate was constant a mask covering the nose and mouth was applied. To this were attached inlet and outlet valves separating the inspired from the expired air. The latter was collected in a large (100-liter capacity) Tissot spirometer. The expired air was collected for periods of about ten minutes, and two or three periods were run. The expired air was then analyzed with the Haldane gas analysis apparatus (portable form). From oxygen consumption and carbon dioxide production thus determined the respiratory quotient and the heat production in calories per square meter body surface per hour were calculated. Surface area was determined on the basis of height and weight from the curve of DuBois and DuBois. Heat production per square meter body surface was finally compared with the normal standards for age as given by DuBois and his co-workers.

at The Russell Sage Institute of Pathology They have shown that in normal individuals the metabolism may vary plus or minus 10 per cent. from the standard normal figures.

DISCUSSION OF EXPERIMENTAL RESULTS

The table on pages 510, 511 summarizes the results of observations on the basal metabolism of 59 patients On account of the large number of cases recorded it is not possible to give the complete details of the experiments, and a few words of discussion are necessary The results on each case represent the average of at least two periods The two periods were run one after the other, the mask being taken off the face in between them, in order to rest the patient. The periods averaged between nine and ten minutes in length, and in no case were less than eight minutes long In 48 out of the 59 cases the percentage of the metabolism in terms of the normal in the two periods agreed within 3 per cent. In 4 cases (Nos. 10, 32, 34, 44) the difference was 4 per cent., in 3 (Nos 7, 13, 40) it was 5 per cent., in 1 (No 56) it was 6 per cent., in 2 (Nos 35, 37) it was 7 per cent., and in 1 (No 17) it was 8 per cent. In none of these cases, however, were the results of either the high or the low period outside of the normal limits, with the exception of No 56, mentioned later

Abnormalities in the character of the respiration, undoubtedly due to nervousness, were observed in a number of instances. Thus the minute-volume of air breathed often varied to an unusual degree in the two periods One might well have expected to find variations in the metabolism associated with this, but such was either not the case or else the variations in the metabolism were proportionally much less than the variations of minute-volume. The minute-volume does not bear the usual relationship to oxygen consumption A similar nervous respiratory reaction may be seen in the rate of breathing, which is not infrequently considerably above normal (Nos. 19, 36, 37, 44, 56, 57) Here again there is no constant relation between the rate of respiration and metabolism, nor does the rapid respiration have any definite effect on the respiratory quotient.

BASAL METABOLISM DETERMINATIONS

Case No.	Name	Register No.	Age	Date	Weight, kg	Height, cm	Temp, buccal degrees C	CO ₂ production per min., C.c.	O ₂ consumption per min., C.c.	Resp. quotient	Minute volume (S.T.P.) liters	Rate of resp	Calories per sq m. per h. ur	Pulse-rate per minute.	Metabolism in per cent of normal	Preliminary diagnosis.
1 F B		1146	31	24/viii	79.1	181.0	98.3	218	266	0.82	6.45	17.9	38.7	73	3	
2 C R B		723	23	18/vii	60.5	174.0		187	238	0.79	9.78		39.2	75	1	
3 M D		746	38	20/vii	53.4	169.5	98.0	172	207	0.83	5.06	15.5	37.3	60	6	
4 G H D		868	32	27/vii	59.3	162.4	99.2	193	236	0.82	5.06	12.6	41.7	95	6	Hyperthyroidism
5 R D		1185	23	26/viii	51.6	173.0		160	204	0.79	4.46	12.5	36.4	81	8	
6 R E		1258	23	22/viii	59.8	176.0	98.6	179	220	0.82	4.80	15.9	36.6	66	8	
7 V E		1283	26	1/viii	53.9	166.5	98.4	169	223	0.76	4.58	13.4	39.6	82	1	Hyperthyroidism
8 J G		904	20	15/viii	55.5	170.3	98.3	163	210	0.78	4.81	19.6	36.4	71	8	
9 P G		872	23	25/vii	52.7	169.0	97.8	181	216	0.84	4.74	13.5	39.3	67	1	Hyperthyroidism
10 G G		1186	27	20/viii	57.3	174.0	98.4	161	224	0.72	4.06	14.3	37.5	76	5	Hyperthyroidism
11 E G		1069	24	7/viii	55.5	164.5	98.7	158	204	0.77	4.18	11.0	35.9	78	9	
12 L R. J		1021	23	14/viii	65.0	174.0	98.2	185	226	0.83	4.88	17.1	36.8	69	7	
13 G H		1227	31	16/ix	63.4	174.5	98.4	204	240	0.85	6.50	20.7	39.5	59	1	Hyperthyroidism
14 K K		1226	23	29/viii	61.8	173.0		180	232	0.78	4.92	14.5	38.2	94	4	Hyperthyroidism
15 F K			26	10/viii	58.9	171.0		178	220	0.81	5.77	21.5	37.6	75	5	Hyperthyroidism
16 M L		1145	19	6/viii	60.2	167.0	98.7	202	233	0.87	5.74	16.5	40.8	83	1	Hyperthyroidism
17 A M		875	22	26/vii	59.3	174.0	98.8	168	233	0.73	5.14	21.1	38.4	70	3	Hyperthyroidism
18 W N		133	24	16/viii	64.8	187.0	98.3	200	247	0.83	5.85	16.3	39.4	66	8	Hyperthyroidism
19 O S		899	19	29/vii	57.7	170.0	98.9	168	222	0.76	5.41	22.3	37.8	78	3	
20 J T		902	21	15/viii	65.5	169.5	98.2	179	236	0.77	4.80	14.5	38.3	58	3	
21 G V		1098	23	13/viii	59.1	166.0	98.8	171	218	0.79	4.84	16.2	38.0	60	4	Hyperthyroidism
22 I Z		1230	22	21/viii	60.2	177.0		187	232	0.81	4.38	12.8	38.4	70	3	Hyperthyroidism
23 S Z		221	24	1/viii	52.1	170.5	97.8	169	216	0.78	4.96	16.7	39.0	64	2	Hyperthyroidism
24 G A		441	24	27/viii	68.2	173.5	97.4	203	254	0.81	5.47	15.6	40.6	80	1	
25 H B		1143	20	4/ix	57.7	170.0	98.2	184	237	0.78	5.38	17.6	40.6	59	3	Hyperthyroidism
26 J A B		866	23	29/vii	58.0	180.5	98.8	189	246	0.73	4.11	17.1	39.9	72	1	Hyperthyroidism

27 J H	1115	27	23/viii	61.6	168.0	97.8	215	243	0.89	5.80	14.1	41.4	65	+	3	Hyperthyroidism
28 J F	291	23	30/vii	58.0	171.8	98.6	186	236	0.79	5.38	17.3	40.6	80	+	3	Hyperthyroidism
29 W H	260	25	24/vii	63.9	177.0	97.8	196	240	0.79	6.23	23.4	39.6	80	+	3	Hyperthyroidism
30 V T	1419	24	17/ix	70.2	182.5	98.0	204	257	0.79	6.57	19.7	38.7	71	+	3	Hyperthyroidism
31 F K	235	27	30/vii	60.7	174.5	98.8	190	245	0.77	5.50	18.3	40.5	83	+	3	Hyperthyroidism
32 J K	1177	31	17/viii	59.8	166.0	98.2	181	236	0.77	5.72	23.5	40.4	72	+	8	Hyperthyroidism
33 J L	884	29	7/viii	64.1	168.0	98.2	208	256	0.81	6.91	28.8	42.5	69	+	0	
34 O M	737	23	23/vii	66.1	176.5	98.6	188	253	0.74	5.49	17.1	39.5	67	+	3	Hyperthyroidism
35 W R	713	30	19/vii	58.4	174.5	97.7	184	244	0.76	5.00	14.3	40.6	60	+	3	Hyperthyroidism
36 G S	1110	22	15/viii	55.0	166.0	98.6	181	233	0.78	6.12	31.1	41.6	82	+	4	Hyperthyroidism
37 S J S.	388	17	24/vii	55.2	171.5	97.2	197	257	0.78	7.64	36.2	44.5	74	+	2	Hyperthyroidism
38 W S.	1149	25	5/viii	61.4	170.5	98.7	197	239	0.83	5.11	19.2	40.1	72	+	2	Goiter simple.
																Mitral insufficiency
39 B S.	1103	20	8/viii	62.3	170.0	98.6	189	247	0.77	5.73	20.1	40.5	73	+	3	
40 W Z.	873	24	25/vii	68.2	174.0	98.6	191	259	0.74	6.01	21.3	40.0	69	+	2	Hyperthyroidism
41 P D.	1273	21	5/ix	56.1	168.5		180	220	0.82	5.23	16.0	38.8	72	+	2	
42 S. G	1284	26	26/viii	61.8	180.0		187	231	0.81	4.93	15.3	37.3	66	+	6	
43 R. C	874	24	17/ix	53.2	176.0	98.3	173	206	0.84	5.15	17.4	36.1	57	+	9	Hyperthyroidism
44 A. R.	881	29	3/viii	52.7	161.3	97.7	159	198	0.80	5.17	24.9	36.8	72	+	7	Hyperthyroidism
45 J J H	766	23	22/vii	61.6	173.5	96.2	170	216	0.79	4.72	17.8	35.6	53	+	10	
46 M. H	1104	23	8/viii	63.4	168.0	98.4	170	216	0.79	5.66	24.8	35.7	62	+	10	Mastoiditis.
																Goiter, simple
47 H N	879	30	27/vii	64.3	181.0	97.8	178	230	0.78	5.89	24.4	35.7	65	+	10	Hyperthyroidism
48 N A P	891	22	31/vii	77.3	191.0	98.2	193	256	0.75	5.16	15.5	35.5	55	+	10	Hyperthyroidism
49 C. H	949	24	14/viii	61.8	164.0	98.6	157	206	0.76	4.09	17.6	35.3	55	+	11	
50 W B H	934	30	9/viii	51.4	167.0	98.5	164	189	0.87	4.45	14.8	35.3	64	+	11	
51 E. M	707	20	13/viii	63.6	171.5	98.2	175	213	0.82	4.62	12.9	35.1	67	+	12	
2 H V	777	24	18/vii	61.4	176.0	98.0	172	197	0.87	3.99	10.3	33.0	59	+	17	
3 E. H.	775	23	22/vii	56.6	161.0	98.8	204	237	0.87	4.65	14.1	43.9	74	+	12	
4 D C	1148	26	30/viii	63.0	177.0	97.8	231	272	0.85	6.15	16.9	44.6	70	+	13	
5 S.	870	24	22/viii	69.1	164.0		286	266	1.08	9.27	15.4	45.8	84	+	16	
S. S.	721	23	19/viii	63.4	173.0	96.8	235	285	0.83	10.80	45.7	46.6	64	+	18	
	933	23	31/vii	59.7	166.5	98.7	213	279	0.77	8.55	53.3	48.0	83	+	22	Hyperthyroidism.
	851	19	23/vii	64.5	172.5	98.8	316	403	0.79	7.27	15.5	65.7	103	+	60	Hyperthyroidism.
	14	27	6/viii	50.0	165.5	99.0	256	344	0.75	7.66	19.8	63.4	120	+	61	Hyperthyroidism.

Case 2 was an extremely neurotic individual and illustrates well these respiratory phenomena. In the preliminary rest period the rate of respiration was 36 per minute. After the mask was put on it increased until it reached 102 per minute in the second period. The oxygen consumption remained practically unchanged (243 c c in the first and 233 c c in the second period), and the respiratory quotient remained normal (0.73 in the first and 0.84 in the second period). The minute-volume was 7.86 liters in the first and 11.69 liters in the second period. It is interesting that in spite of this marked evidence of nervousness his pulse only changed from 60, while he was at rest without the mask, to 78 in the first and 71 in the second period. The heat production was the same in both periods, and the metabolism 1 per cent. below normal.

The average respiratory quotients were normal in all except Case 55. This patient breathed deeply at a nearly normal rate (minute-volume 9.27 liters) and probably "washed out" carbon dioxide.

The basal metabolism was within 10 per cent. of the normal limits in 48 cases, and within 15 per cent. in 53 cases. One patient (No. 52) had a metabolism 17 per cent. below normal, and at a second observation some time later it was found to be 19 per cent. below normal. No cause for this low metabolism was discovered. Two cases (Nos. 58, 59) had a metabolism 60 and 61 per cent. respectively above normal. These were both frank cases of exophthalmic goiter. Three other patients had a metabolism from 16 to 22 per cent. above normal. One of these was a man with hysterical aphonia, and the other two were nervous individuals, rather typical cases of "irritable heart," who were without evidence of hyperthyroidism.

DISCUSSION OF CLINICAL CASES

Fifty-nine cases are reported on whom the basal metabolism has been studied. Two of these (Nos. 58 and 59) showed all the classical symptoms of exophthalmic goiter. The remaining 57 cases all had hearts that were normal on physical examination, but had the typical symptom-complex which is character-

istic of the so-called "irritable heart of soldiers" It is to this group of 57 cases that attention is especially directed In 24 cases (see table, pages 510, 511) the diagnosis on transfer to this hospital or the preliminary diagnosis of the Ward Surgeon here was hyperthyroidism, in 14 it was functional heart disease, and in 13 it was some type of organic heart disease. The others were sent to the hospital with various diagnoses (mumps, flat foot, hernia, periorchitis, etc.) After careful study here the diagnosis of "cardiac disease, functional" was made in all these cases The great majority were of what may be termed the "constitutional type"—with symptoms dating back over many years—but a few (Nos. 9, 25, 41, 46) dated the onset of their symptoms to a recent attack of rheumatic fever or other infection. In these cases, of course, the possible existence of a slight organic lesion cannot be excluded In several (Nos. 8, 51, 56) the symptoms developed quite definitely after being under fire in France.

With regard to the relation between hyperthyroidism and "irritable heart" it is of interest to analyze the studies of basal metabolism in this group of 57 cases, bearing in mind the fact that definite overactivity of the thyroid gland evidences itself by causing the metabolism to increase above the normal limits. The normal variations are usually accepted as being 10 per cent. above or below the normal standards, but no very definite significance can be attributed to a rise of 15 per cent. above the normal. Of the 57 cases studied, 52 had a metabolism below 10 per cent. above and 54 below 15 per cent. above the normal standards. The metabolism in all of these was thus essentially normal. Three cases, with a metabolism of 16, 18, and 22 per cent. respectively above normal, must be considered from the point of view of their increased metabolism. The first of these was a fat, neurotic, constitutionally inferior man with a history suggestive of epilepsy. The second was the patient mentioned before with hysterical aphonia. In neither instance did the diagnosis of hyperthyroidism suggest itself at all. The third was a nervous individual who complained largely of pain in the chest on exertion. A rather full thyroid gland, which was,

however, without thrills or bruits over it, slight lid-lag, and the possibility of this being a case of Graves' disease, but the general appearance and the history made it extremely unlikely that this diagnosis is the correct explanation of the high metabolism. Considering the fact that many of these patients were unusually nervous, it is rather remarkable that so few had a metabolism at or so slightly above the normal limits.

In spite of the fact that the metabolism studies lend little support to the view that overactivity of the thyroid gland is a factor of importance in this group of 57 cases, nevertheless the clinical diagnosis of hyperthyroidism was made by competent observers in 24 instances—and curiously enough none of these were patients with a metabolism above normal. That the diagnosis was made so frequently depends undoubtedly in part on lack of time and lack of proper facilities to study the patients, but in part, also, on certain superficial resemblances between these cases and cases of exophthalmic goiter. Nervousness, often in marked degree, is almost constant in the functional heart cases. A tremor of the hands is present which cannot always be differentiated from that of Graves' disease. The thyroid gland is often rather full and the isthmus easily palpable, but this is usually accounted for by the fact that the patients are at an age when the thyroid is often somewhat large, and in many instances by the patient coming from a region where goiter is endemic. Thrills and bruits over the gland, so frequently found in exophthalmic goiter, are very rare. Eye signs suggesting Graves' disease are not very uncommon, and well-marked lid-lag was noted in several cases in which there was little or nothing to suggest a diagnosis of hyperthyroidism. Tachycardia, reaching 120 to 130 or even more, is very frequently present when the physician examines the case. This tachycardia is, however, essentially different from that seen in exophthalmic goiter, for it disappears if the patient is allowed to lie down quietly for half an hour. The pulse counts taken by the nurse in the morning are usually normal, and in only 2 cases out of the 57 was the pulse-rate above 90 during the metabolism observation. It was, indeed, above 80 in only 9 cases of the

group This tendency of the pulse-rate to fall to normal at rest and in the absence of excitement is quite different from the characteristic findings in exophthalmic goiter. One might argue that these are mild cases of Graves' disease in which there is only slight overactivity of the thyroid, insufficient to cause a demonstrable rise in the metabolism. Several points, however, are apposed to this hypothesis. In the first place, the nervousness and tremor are often so marked that, from comparison with other definite cases of Graves' disease, one could be certain that the metabolism would be increased. Second, if cases of mild hyperthyroidism were so common it would be almost inconceivable that outspoken cases would remain rather rare. And finally, the whole clinical picture of the two conditions is fundamentally different. In the cases of "irritable heart," as seen at this hospital, one usually gets a history of prolonged, often life-long, nervousness, associated with weakness, rapid fatigue, and lack of energy or ambition. There is always the tendency for the patient to "spare" himself, to "go slow," and to "take his own time." The more acute nervousness, with rapid loss of weight and diarrhea, which is characteristic of Graves' disease, is absent. The nervous activity, the restlessness, the physical and mental energy of the patient with hyperthyroidism give place in the cases of "irritable heart" to a condition of physical and sometimes mental inertia, and a desire to evade even the normal strain of life. The patient with exophthalmic goiter will usually take his rest-cure only under protest, the patient with "irritable heart" would adapt himself to the same treatment only too readily. Psychologically they are fundamentally different.

The observations reported here thus confirm the opinion expressed by Lewis and his co-workers¹ in England, who investigated the same problem by studying the effects of administering thyroid extract to patients with "irritable heart," and they lead us to conclude that in America also hyperthyroidism does not play a significant rôle in the production of the symptom-complex of the "irritable heart of soldiers."

¹ Report upon Soldiers returned as cases of "Disordered Action of the Heart" or "Valvular Disease of the Heart," Medical Research Committee 1917

NOTES ON THE DIAGNOSIS OF ACUTE INFECTIONS IN THE THORAX

BY MAJOR LAWRENCE LITCHFIELD, M C , U S A.

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FACED by our mistakes in diagnosis, our disappointments in treatment, the very different observations and conclusions of apparently equally good men, and the variation in physical signs and subjective symptoms produced by what seem to be identical conditions, we feel at times that this subject is chaotic and our gropings futile.

In considering the diagnosis of the more puzzling and anomalous cases of disease of the chest we must recognize at the outset that certain physical signs have been misunderstood, and certain errors of conception and interpretation tend to perpetuate themselves. The medical student studies, for instance, a typical case of pneumonia, follows it to the postmortem, where the diagnosis is confirmed, and thereafter dulness, prolonged expiration, bronchial breathing, bronchophonic voice and whisper, and crepitant râles stand in his mind for lobar pneumonia, not merely for interesting phenomena of acoustics which may be due to very different causes under different conditions.

PNEUMONIA

The transition from acute bronchitis to a bronchopneumonia, whether interstitial or lobular, may be very insidious. A chill and sudden or gradual rise of temperature and sharp pleuritic pain in one side (the occurrence of a unilateral pain in the chest is strongly indicative of pneumonia) and a sudden change of the R. P. ratio are the signs likely to mark the beginning of the pneumonic process. The true rusty sputum of lobar pneumonia is at least very rare in the streptococcus cases. The viscid, gluey sputum of pneumococcus infection I have never seen in a

streptococcus pneumonia Profuse hemoptysis may occur from either infection One of our streptococcus pneumonias was estimated to have lost 1500 c c of blood by hemoptysis In our streptococcus cases the leukocytosis was not as high as it usually is in pneumococcus infection, and the proportion of polymorphonuclear leukocytes was not as great

The clinical picture of streptococcus bronchopneumonia (probably in all cases of the interstitial type as described by McCallum) was very well described at Camp Lee by Lieutenant Rivers as follows "Sore throat, coryza, cough, mucopurulent expectoration, headache, general malaise, with pains throughout the body, fever, anorexia, and at times nosebleed, are the usual symptoms elicited in taking the history of the onset. During this stage the patient may not go to bed and may even remain on duty After the above symptoms have existed for a few days the patient may be taken with a chill and a sharp pain in one side of the chest, and it is at this time that he is sent to the hospital A few cases seem to become ill suddenly with a chill and pain in the chest "

As the interstitial pneumonia develops "the picture becomes a very distressing one There is a look of anxiety on the patient's face, dyspnea becomes more and more extreme, with both inspiratory and expiratory embarrassment, he is restless, cannot sleep, the face becomes congested, puffy, and slightly cyanotic, there is a distressing cough," which is probably in large part due to the irritation of the pleura, "and at times literally exhausts the patient The eyes are wide open, with glistening sclera, the lips parched and cracked, the tongue, mouth, and throat dry, so that often there is difficulty in speaking, and questions are answered briefly and in a whisper The patient sometimes fairly fights for air, there may be drenching sweats, the temperature is irregular, the pulse is rapid, often weak and running—not at all the bounding pulse of lobar pneumonia "

If, however, the patient develops a large pleuritic effusion with only slight lung involvement the picture may be very different He is quiet, does not wish to be disturbed, may be drowsy, and hard to arouse

The importance of the bacteriologist in the proper study of these cases cannot be overestimated. Inefficient laboratory technic leads to failure in typing of the pneumococcus, so important in the treatment of the type "1" cases, and also to the classification of many streptococcus cases as group "4" pneumonias, and of many hemolytic streptococcus as non hemolytic. That the non hemolytic streptococcus ever causes pneumonia is very much to be doubted.

Blood-cultures in the early stages of the hemolytic cases were very rarely positive, occurring but once in the last 23 cases. In the last stages of the fatal cases it was more common. The sputum must be relied upon chiefly for the recognition of the invading organism.

Lieutenant Rivers, working on my cases in the ward and in the laboratory, developed the following valuable notes on what he called "pit falls"

1 The collection of the sputum is most important. Most interns, to say nothing of nurses and orderlies, do not know what a good specimen of sputum is. If collected during the night and sent to the laboratory the next day, to stand about indefinitely, it is autolyzed before the attempt is made to examine it. After it is autolyzed it cannot be washed. The sputum should be collected by an expert who sees that the patient coughs the specimen taken directly from the lungs after the mouth has been rinsed.

2 Not enough sputum is usually added to the Avery tube. From $\frac{1}{2}$ to 1 c.c. of the washed sputum should be taken.

3 The acid developed by the growth of the pneumococcus or streptococcus in the glucose medium, unless neutralized, will precipitate bile-salts in a colloidal mass which cannot be cleared up.

4 The Avery tube should not be used for agglutination tests, but only for the precipitin reaction. Type IIa and Group IV are best differentiated by agglutination.

5 Glucose-agar plates or glucose broth should not be used for working with hemolytic streptococcus on account of the acid formation, which interferes with hemolysis.

Rusty sputum with the classical signs and symptoms followed by a crisis generally means lobar pneumonia, but lobar pneumonia may show a mucopurulent sputum due probably to a mixed infection, as with *Bacillus influenzae* or hemolytic streptococcus, and the defervescence may occur by lysis instead of by crisis

The differentiation between lobar pneumonia and bronchopneumonia, either interstitial or lobular, although oftentimes

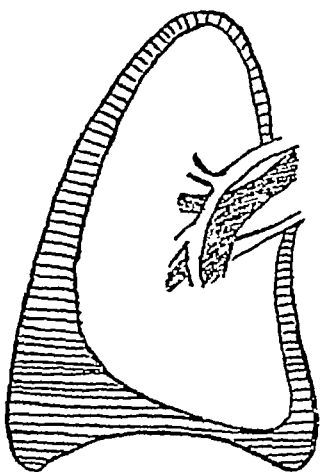


Fig 108—Diagram of distribution of pleuritic effusion or exudate. Frozen sections will not show this because the negative pressure of the pleural sac and the vitality of lungs and muscular tissue are no longer acting

very difficult, can generally be made if careful clinical observation is made by an experienced internist, and if an equally experienced bacteriologist and roentgenologist work hand in hand to get the necessary reliable data

We must recognize from the outset that the traditional signs of pneumonic consolidation may occasionally be present over a pleuritic effusion. On the other hand, tubular breathing, vocal resonance, and the abnormal conduction of the whispered voice, usually characteristic of hepatization, may be diminished or absent over a pneumonic consolidation on account of (1) plugging of bronchi (may be cleared by energetic coughing), (2) by pleuritic exudate, serous or plastic, (3)

possibly by a thickened pleura (I have rarely if ever seen on an autopsy table sufficient thickening of the pleura to explain the physical signs so often disposed of on that hypothesis), (4) pressure on the bronchi leading to the solidified area, (5) unknown causes, probably due to interference, reflection, and absorption of the sound waves due to varying combinations of density and pressure

While bronchopneumonia is usually disseminated and often-

times impossible to locate by percussion or auscultation it is often unilateral and sometimes causes the consolidation of an entire lobe, thus giving the physical findings of a lobar pneumonia. On the other hand, a pure pneumococcus infection which is associated with lobar consolidation may kill the patient before there are any physical signs beyond diffuse pulmonary congestion. We usually make the mistake of expecting the signs of advanced hepatization in the very early stages of the disease. This is well emphasized by Landis.

One of my most valued experiences during the past year has been the opportunity at Camp Lee of working for many months with Major Merritt, who was one of the first roentgenologists to recognize the great value of fluoroscopy in acute thoracic conditions and the infinite superiority of the screen over the plate methods in these cases. It is very largely to Major Merritt's tutelage that I owe my appreciation of this method. Except for the purpose of record and teaching the use of plates should be discouraged. When plates or prints are made for the latter purpose the greatest care is necessary in developing and printing in order to show truthfully the progress of a case.

In describing and recording the shadows observed in this work we adopted the liver shadow of the case under observation as the standard of density. This we denoted as "1," describing less dense shadows as fractions and the least noticeable change as "smoky."

The value of fluoroscopy as an adjunct to a careful study of the history and physical findings in all cases of acute infections within the chest cannot be overestimated. In lobar pneumonia the Roentgen phenomena which we observed were the following. First, localized or diffuse cloudiness with marked restriction of the diaphragmatic excursion on the affected side (except in cases of central pneumonia free from pleuritic irritation). Not infrequently a distinct localized shadow in the lung will clear up in the course of a few hours, while a similar shadow appears in a different lobe, possibly on the opposite side. This may proceed to a complete lobar hepatization. The stage of hepatization is characterized by a shadow which increases in density

as consolidation advances until a density of "1" is attained, and if it be a lower lobe the line of the diaphragm is lost except when it is outlined on the left side by air in the stomach. There is usually diffuse smokiness over the balance of the lung on the affected side, and not infrequently on the opposite side. There is no stated period for resolution to occur. A partial hepatization may clear up at the end of twenty-four to forty-eight hours, and more complete consolidation shows a gradual fading of the density of the shadow until after days, or possibly weeks, an almost normally clear area is left, traversed more or less with linear markings extending from the hilus to the periphery. In cases of delayed resolution after the density of the shadow has diminished to " $\frac{3}{4}$," " $\frac{1}{2}$," or less, it may remain stationary for several weeks. We have several times seen the development of a shadow of the density of "1" in the parenchyma of the lung with positive laboratory findings and the clinical phenomena of severe pneumonia, but without the expected physical findings, followed by crisis and recovery, and the disappearance of the shadow, which had never reached the periphery and naturally had not been accompanied by signs of pleurisy or by any restriction of the movements of the diaphragm. In these cases the shadow faded into the normal lung with a mossy or lace-like margin. One of these cases did not recover and the diagnosis of central or hilus pneumonia, which could not be made out by physical examination, was confirmed by autopsy. Major Merritt, Lieutenant Stern, and myself gradually gained the conviction that a shadow approaching the density of "1" situated near the hilus and gradually fading toward the periphery was, in all probability, due to hepatization, and that a shadow of a like density situated at the periphery and fading toward the hilus was, in all probability, pleuritic fluid. In the latter case the margin might be sharply defined or might gradually fade out, according to the location and character of the adhesions which confined the fluid.

These observations indicate that at Camp Lee during the winter of 1917-18 the development of pneumonic consolidation in adults was the opposite of that which has been so well described

in children by Chapin and by Mason. As hepatization approached the periphery it was found that it might cause dulness before it caused bronchial breathing or bronchophony. On the other hand, I feel that hepatization at the periphery which does not extend deeply toward or perhaps to the hilus, may cause suppression of breath sounds simulating a pleuritic effusion.

A logical combination of fluoroscopy and percussion is sometimes very interesting. If fluoroscopy reveals a shadow which does not move with respiration it is either due to a pocket of fluid or an area of hepatization fixed to the chest wall by pleuritic adhesions. The percussion will show whether this pathology is anterior or posterior or includes the entire anteroposterior diameter of the chest. The shadow may approximate the location and area of the middle lobe and percussion may determine in the presence of other phenomena of pneumonia whether it is the middle lobe or the upper portion of the lower lobe which is involved. If the shadow is movable, tending to follow the shadow of the diaphragm down and up, it indicates either hepatization or a pulmonary abscess. Percussion may show whether it is in the middle lobe or the upper part of the lower lobe, while a very sharply defined margin on the screen or on the plate is evidence in favor of abscess formation or an interlobar empyema, the shape of the shadow in the latter case being sometimes suggestive. Cases of lobar or bronchopneumonia which later develop a hectic type of temperature with chills, etc., and in which the fluoroscope or the skiagram does not show the dense well-defined shadow of a single large abscess, or the recognized evidence of empyema, are very likely to die of multiple pulmonary abscesses. This is an observation of Landis which we confirmed at Camp Lee.

PLEURISY WITH EFFUSION

Most physicians think of a pleuritic effusion as gradually accumulating in the pleural sac and pushing up the lung, which, being full of air, floats on its surface.

Tradition has it that the upper surface of the fluid follows a graceful, compound curved line, ascending steeply from the

front of the chest, across the axilla, and on toward the spine. This sometimes seems to be supported by *percussion* owing to the resonance of the lung underlying a varying amount of fluid.

Let us consider the physical facts. The pleura is a closed and empty sac not communicating with the outside air. Its visceral and parietal surfaces are in contact and held so by the fact that when the capacity of the chest is increased (enlarged) by raising the ribs and depressing the diaphragm the lungs are expanded by the inrush of air. If the glottis were suddenly occluded and the chest expanded the lungs would be distended by the inrush of blood and to some extent by the expansion of the air in the lungs and of the tissues themselves. Of course we cannot conceive of a vacuum being created in the pleural sac.

Let us note here one other important fact. The elasticity of the lungs is acting all the time and acting in a direction away from the pleura, tending to empty the lungs and contract them. This is the force which empties the lung when the chest is opened, and it acts constantly all over the surface of the lung and acts centripetally. This is the fundamental reason of the negative pressure in the pleura, and this negative pressure is greatly increased by the expansion of the chest. This negative pressure restores the dome of the diaphragm when that muscle relaxes and favors (with the plus pressure of the abdominal cavity) the gradual displacement of abdominal viscera into the chest by evisceration, when the diaphragm is paralyzed. This negative pressure in the one pleura, when not balanced by a corresponding negative pressure on the other side, tends to displace the mediastinum.

So much for the normal, now for the pathologic. Imagine some fluid in the pleural sac. Is it possible to conceive of a "horizon" without air over the fluid in a sac with negative pressure? Is it not natural to suppose that this fluid will be distributed over the entire pleural surface—the law of gravity determining only an increased thickness of the "layer" of fluid toward the base—and that with each expansion of the chest, with the pull of the chest wall away from the lung, this fluid in the pleura will tend to readjust itself and will act simultaneously

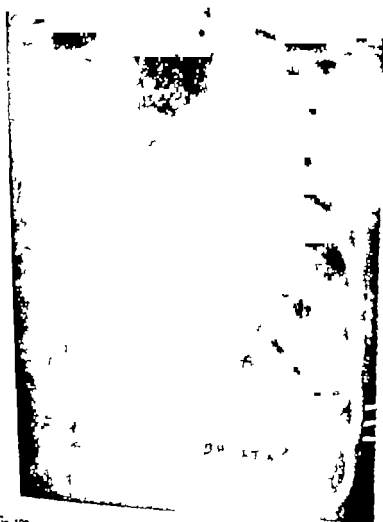


Fig 109.—Plate of a massive pleuritic effusion on left side. Note displacement of mediastinal shadow to the right. The trachea and large bronchi show normally well. A poorly defined stomach bubble, possibly encroached upon by right lobe of liver enlarged. (These plates were made by Captain Leighton R. Cozzan and Captain James F Kelly of the Base Hospital, Camp Grant, Ill., who have been assisting in their assistance in this study.)

from viscera. There can be no upper surface of the fluid in the pleura, much less a horizon.

Furthermore, the greater the amount of fluid exudate in the pleura, the less the negative pressure, until finally the pressure becomes positive and eventually so strongly positive that the

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with the air entering the lungs? The fluid will accumulate most where the parietal pleura moves most and quickest from visceral pleura on inspiration, therefore Litten's sign is quickly lost. Fluid will tend, however, to move to every point where there is a tendency on inspiration for parietes to move away



Fig 109—Plate of a massive pleuritic effusion on left side. Note displacement of mediastinal shadow to the right. The trachea and large bronchi show unusually well. A poorly defined stomach bubble, possibly encroached upon by right lobe of liver enlarged. (These plates were made by Captain Leighton R. Cornman and Captain James F. Kelly of the Base Hospital Camp Grant, Ill., who have been untiring in their assistance in this study.)

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Furthermore, the greater the amount of fluid exudate in the pleura, the less the negative pressure until finally the pressure becomes positive and eventually so strongly positive that the

intercostal tissues are bulged outward, the ribs elevated, the diaphragm depressed, and the entire mediastinum displaced markedly to the other side. Such a case is shown in Fig 109, which shows unusually well the displacement of the trachea.

Although there is usually some pleuritis with lobar pneumonia, a large exudate is unusual, while with the hemolytic streptococcus pneumonias a large exudate is the rule. Therefore when the laboratory report of blood or sputum examination is streptococcus, we should watch carefully for signs of fluid. The typical case of pleurisy with effusion cannot be overlooked if the attendant is on his guard. The severely painful catch in the breathing, which inhibits the expansion of the side affected, the painful, persistent, unproductive cough followed by the signs of fluid, of which the most important are flatness on percussion with the characteristic feeling of resistance, absence of tactile fremitus, suppression of breath sounds or distant breath and voice sounds and egophony with absence of Litten's sign, lateral displacement of the area of superficial cardiac dullness, Grocco's sign, dullness on percussion over the spines of the vertebræ, and, finally, bulging of the intercostal spaces, or even of the entire side of the chest, may leave no room for doubt. (Dilatation of the pupil on the affected side is often an interesting phenomenon, but scarcely has any diagnostic value.) In the case of a large effusion in the right pleura, there may be dullness and bronchovesicular breathing on the left side over the displaced heart with Litten's sign exaggerated on that side.

Just a word regarding spinal percussion, *i. e.*, percussion over the spinous processes of the vertebræ. Marked dullness here is a good sign that a neighboring dull area is fluid and not hepatization. It may be explained by the negative pressure on the sound side, displacing the fluid toward that side and the vertebræ acting like an inverted Herschfelder's pleximeter carrying the stroke and the sound through the spinal muscles.

Use the ulnar side of the hand for palpation of fremitus. Percussion upon the distal phalanx of the finger used as a pleximeter and held firmly applied to rib or intercostal space, one at

a time. Percussion with light, almost soundless, staccato touch. But if the case has begun with signs and symptoms of pneumonia and the fluid has accumulated insidiously, and especially if, as noted above, the physical signs are anomalous, or even simulate those of hepatization rather than fluid, we find fluoroscopy of inestimable value.

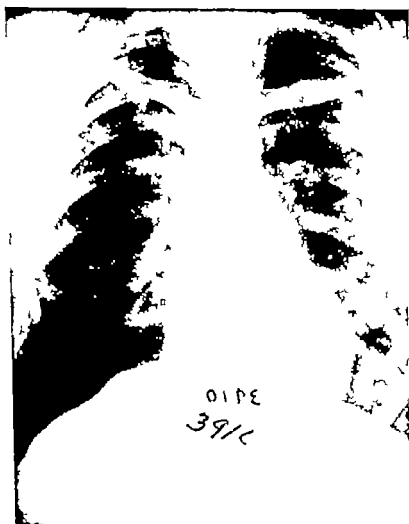


Fig. 110—Aug 28 1918 Beginning pneumonia, right lower lobe Spasm of diaphragm on right side two distinct curves. Cloudiness of left base, shown by stereoscopic plates to the left lower lobe Plate taken for suspected tuberculosis of the left upper lobe Bad family and personal history acute symptoms due to onset of lobar pneumonia.

When one side of the chest does not expand with respiration we must first consider whether it (1) *cannot* or (2) *will not* expand. 1) May be due to (a) a large pleuritic effusion, (b) an excessive pneumothorax, (c) an advanced emphysema of

course, is not an acute condition) (2) Is due to pain—(a) pleuritic, (b) peritoneal, or (c) in the chest wall (the so-called intercostal neuralgia or pleurodynia) If the chest cannot expand, it is in the position of expansion, and the ribs, if visible

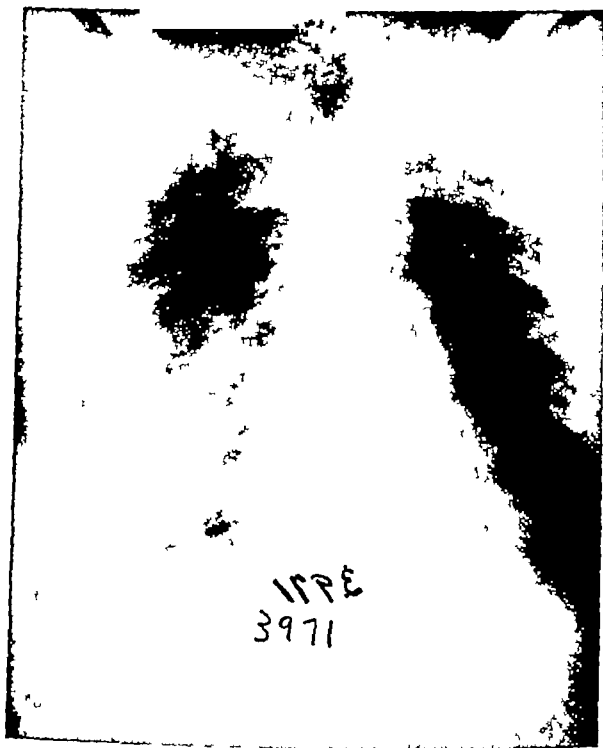


Fig 111 —Aug 31, 1918 Distinct shadow in right lower lobe, plainly seen on the screen to move up and down with respiration Outline of diaphragm not obscured on the screen Left lower lobe has almost entirely cleared Physical signs, Sept 1, 1918, right lower lobe, dulness, tubular breathing, bronchial voice and whisper

on the fluoroscopic screen, are nearly horizontal and widely separated, while the diaphragm is flattened

If the side of the chest "will not" expand because inhibited by pain, the ribs are oblique and close together and the diaphragm is highly domed

In considering the differentiation of fluid from hepatization by fluoroscopy we note the following facts

The density of the shadow may be the same in either case

A shadow which moves with respiration must be in the lung

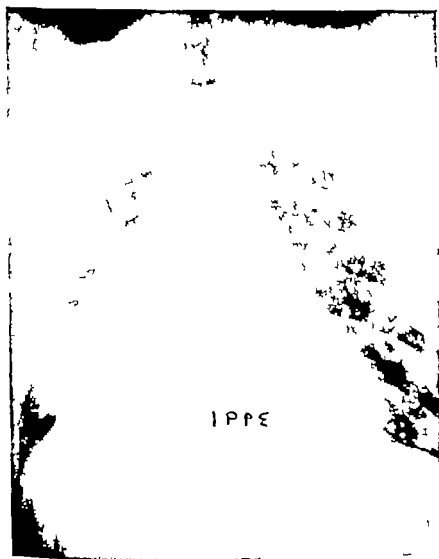


Fig 112.—Sept. 3 1918 Right pleural effusion added to right lower hepatization. Line of diaphragm almost lost. Fluid causes smokiness to very apex. Entire left side is clear. Mediastinal shadow slightly drawn to left.

A small amount of fluid in the pleural cavity will obscure the outline of the diaphragm and shade to a faint smokiness at the apex.

Inflammation of the pleura always inhibits the respiratory movements of the diaphragm

Most of these cases are examined horizontally, but when their

condition does not contraindicate their sitting up, the effect of gravity may be noted in a darkening of the shadow below, while it becomes lighter, but not clear, above

Coughing, if fairly forceful, shows a distinct and striking change in the density of the shadow due to fluid. It "flashes"

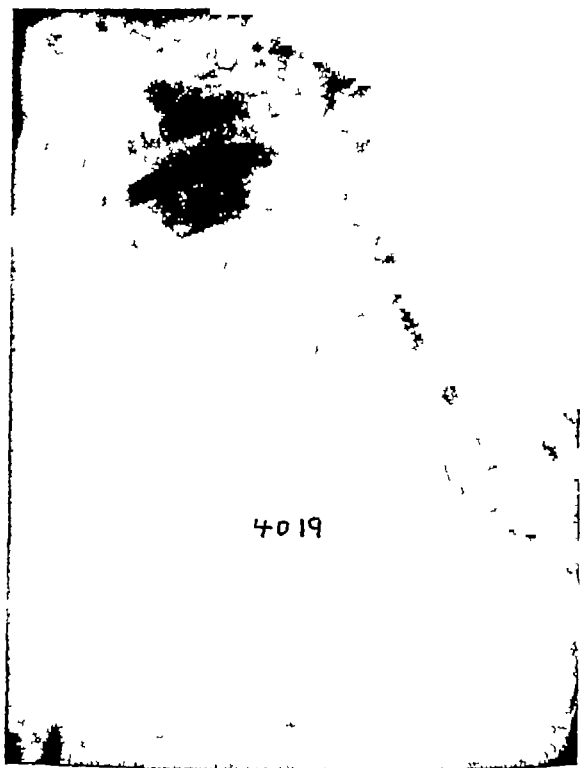


Fig 113—Sept 5, 1918. A typical crisis occurred during the preceding night. From fluoroscope or plate the diagnosis would be, fairly large pleuritic effusion. Marked but not great displacement of mediastinal shadows.

darker, because it is concentrated in a smaller space, forcing a corresponding amount of air out of the lungs when the thoracic capacity is suddenly diminished.

The mediastinal shadow must be displaced toward the opposite side when there is fluid in the pleural sac.

An extensive very dense shadow extending over one entire side of the chest must be due to massive hepatization unless the mediastinal shadow is distinctly and markedly displaced to the opposite side. This is plainly shown by percussion or by the screen or plate. Usually the trachea also may be clearly seen

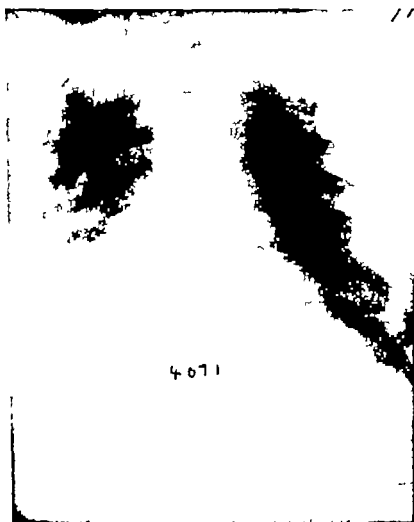


Fig. 114—Sept. 8, 1918—This plate shows distinct absorption of the pleuritic exudate and evidence of the right lower hepatization persisting. On the screen the diaphragm could again be plainly seen.

to be displaced by the latter methods. As mentioned under pneumonia a shadow at the periphery shading lighter toward the hilus is probably due to fluid, in an adult.

A shadow near the hilus fading toward the periphery is probably hepatization.

A sharp upper line of demarcation of a shadow favors pneumonia (lobar).

By careful observation we can sometimes make out waves in the shadow of the fluid, due to the heart's impulse, when the patient is recumbent and the amount of the fluid not too great. The displacement of the mediastinal shadow is the only sign that indicates the amount of fluid present. Therefore, in plat

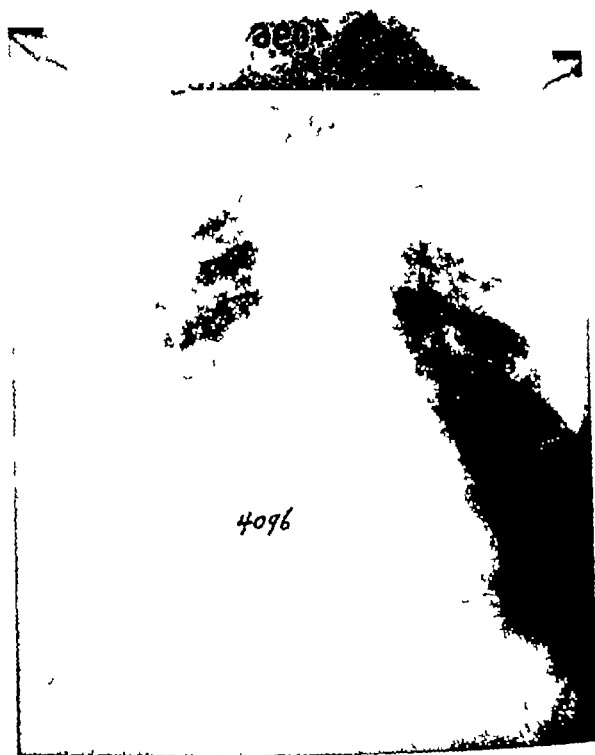


Fig 115—Sept 11, 1918 Patient walked to x-ray room in good spirits. Has improved rapidly ever since his crisis. Fluid absorbing rapidly, although not nearly as rapidly as it came. On the screen entire line of right diaphragm seen, also shadow moving in right lower lobe.

ing chests with possible fluid, it is very important to get the entire normal side on the plate so that the displacement of the mediastinal shadow can be better estimated. The accompanying plates illustrate well the need of this.

I wish to mention here with emphasis the value of postmort

tem examinations by the Roentgen ray when an autopsy cannot be obtained. The only caution necessary is that all orifices of the body be carefully and efficiently closed with cotton tampons.

The information to be obtained by the postmortem use of the aspirating syringe should also be remembered in baffling cases where an autopsy is denied.



Fig. 116.—Sept. 16 1918. This is a film as we had no plates. It is one of a stereoscopic pair, however, and plainly showed that the remaining shadow in the lower right was in the substance of the lung. Mediastinal shadow entirely turned to the normal position.

There is no difference in the shadows produced by serous and purulent effusions. The clinical picture and the exploring needle make this differentiation.

In pneumothorax, either with serous fluid or pus, the maintenance of a *horizontal* surface and the demonstration of waves upon this surface by tapping or jarring the chest are well known.

By careful observation we can sometimes make out waves in the shadow of the fluid, due to the heart's impulse, when the patient is recumbent and the amount of the fluid not too great. The displacement of the mediastinal shadow is the only sign that indicates the amount of fluid present. Therefore, in plat

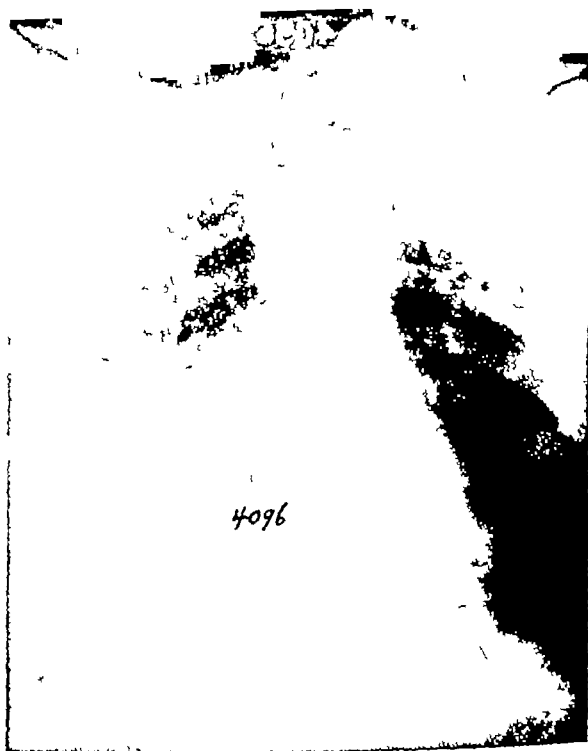


Fig 115—Sept 11, 1918. Patient walked to x ray room in good spirits. Has improved rapidly ever since his crisis. Fluid absorbing rapidly, although not nearly as rapidly as it came. On the screen entire line of right diaphragm seen, also shadow moving in right lower lobe.

ing chests with possible fluid, it is very important to get the entire normal side on the plate so that the displacement of the mediastinal shadow can be better estimated. The accompanying plates illustrate well the need of this.

I wish to mention here with emphasis the value of postmor

tem examinations by the Roentgen ray when a diagnosis is to be obtained. The only caution necessary is that the chest of the body be carefully and efficiently closed with a cotton

The information to be obtained by the post mortem examination of the aspirating syringe should also be remembered in pathological cases where an autopsy is denied.



Fig. 116—Sept. 16 1918. This is a film, as we had no plates. It is one of a stereoscopic pair however, and plainly showed that the remaining shadow on the lower right was in the substance of the lung. Mediastinal shadow entirely returned to the normal position.

There is no difference in the shadows produced by serous and purulent effusions. The clinical picture and the exploring needle make this differentiation.

In pneumothorax, either with serous fluid or pus, the main feature of a *horizontal* surface and the demonstration of waves upon this surface by tapping or jarring the chest are well known.

The absence of the traditional physical signs in some cases of pneumothorax is quite remarkable and as yet unexplained

We noted in 2 cases of right-sided pneumothorax a very definite engorgement of the superficial veins in the upper half of the anterior surface of the chest on the affected side, and a very striking distention of these veins—also confined to the affected side—during coughing. Both these cases also had a definite dysphagia. The unilateral venous distention and the dysphagia both disappeared when the pressure in the pleura was relieved by aspiration.

The use of the x-ray after operations for empyema, to determine whether all "pockets" have been drained and to watch the progress of the case, is very important.

If 5 per cent thorium sulphate solution is used to make the cavity visible it should be injected on the fluoroscopic table and quickly *washed* out, as it is quite irritating and may cause quite a little hemorrhage from the granulating surfaces.

In these pocketed empyemas we sometimes observed a shadow more dense than the liver. They were often at the lateral border of the chest parallel to the spine, but might be along the mediastinal shadow or even anterior to the pericardium. We had one case of pus in the pleura at the right border of the heart which, by fulness, pulsation, and pain, at first suggested aneurysm.

PERICARDITIS

In cases of pericardial effusion we may get a fluoroscopic shadow of characteristic shape and location, and which differs from the shadow of a large heart by the slightness or even absence of visible pulsations, and very often by the fact that we can feel the apex impulse well within the outline of the shadow. This is a valuable guide for the use of the exploring needle. I prefer to explore to the left of the heart, but in one case we were misled here by a pocketed empyema of the pleura bordering upon and overlapping a fairly large serous pericardial effusion.

In the dry stage a pericarditis may cause very severe pain. I recall one case that occurred suddenly without discoverable etiologic relations, was accompanied by loud crackling friction

sounds all over the precordium, required three generous hypodermic injections of morphin the first day, and disappeared without leaving a trace within three days. This man had had a chronic nephritis, of which, however, there had been neither sign nor symptom for probably two years.

We must ever keep in mind the possibility that an abscess elsewhere complicating an intrathoracic condition may determine a lethal termination because discovered too late.

I can mention three regrettable cases from my own observation. A pericecal abscess, an empyema of the knee (which was thought to be a simple serous arthritis), and a subhepatic abscess. Beware of these conditions after operations for retrocecal appendicitis which is followed by pneumonia. Although the pneumonia may be definite, ask yourself if it accounts for the entire picture.

EMPHYEMA AT CAMP DODGE¹

BY LIEUT.-COL. JOSEPH L. MILLER, M C, U S A., and
CAPTAIN FRANK B. LUSK, M C U S A.

September 26, 1918

DURING the year preceding September 20, 1918, approximately 800 cases of pneumonia were treated at the Base Hospital. Of this number, 276 cases from the opening of the camp to March 20, 1918, were chiefly lobar pneumonias due to the pneumococcus. From this date until June 1st 464 cases were treated, chiefly lobular in type, and due to the streptococcus. From June 1st to September 1st the pneumococcus form again predominated. This discussion is confined to pneumonia and empyema prior to June 1st.

Among the 276 cases of pneumonia prior to the streptococcus epidemic empyema appeared as a complication in 17.4 per cent. Its frequency showed a progressive increase—October, 2.3 per cent., November, 12.2 per cent., December, 17.3 per cent., January 27.9 per cent., February, 24.5 per cent. With the appearance of the streptococcus infections in March the incidence of empyema rose to 42.5 per cent., falling to 29.5 per cent. in April and to 22.4 per cent. in May. With the exception of the first few weeks of the epidemic empyema was, therefore, not more frequent as a complication than it had been in the preceding months.

The monthly number of pneumonia patients entering the hospital from October 1st to March 1st varied from 39 to 58. As shown by these figures, at no time during this period was there a real epidemic. During March the number rose to 165, April, 242, May, 103, dropping down to 24 in June.

¹ A report on this same subject was made at the meeting of the Army Assoc. in June 1918. At that time complete statistics were not available. Difference in figures in the two reports can be explained on this basis.

The type of empyema was the same in the period preceding the epidemic as it was during the epidemic. Comment was made early in the winter upon the presence of pus pockets, the difficulty in making the diagnosis, and the unfavorable terminations. On account of the incompleteness of the bacteriologic examination it is impossible to say whether many of these may not have been streptococcus infections, although the laboratory reports on the sputum during this period showed only infrequently the presence of the streptococcus, and the pathologist reported a lobar pneumonia type.

The treatment of this group of so-called pneumococcus empyemas was early rib resections and drainage. The mortality in 40 cases was 52.5 per cent. Inasmuch as 8 of these were not operated upon either because the complication was not recognized during life or the condition of the patient rendered operation inadvisable, only 32.5 per cent of those operated upon died. In those dying after operation undrained pus pockets were frequently found.

With the advent of the streptococcus epidemic empyema not only became more frequent, but appeared very early, and a fatal termination was reached much sooner than in ordinary empyemas. Two patients with well-developed empyema had drilled two days previous. Empyema was never observed except as a complication of a definite pneumonia, although the lung involvement was not necessarily extensive. In the 109 cases coming to autopsy, bronchopneumonia, either alone or combined with lobar pneumonia, was present in 78, or 71.5 per cent. Clinically it was often exceedingly difficult, especially in the confluent forms, to determine whether the process was lobar or lobular. In 53 of the 109 cases where the diagnosis of lobar pneumonia was made, autopsy showed a bronchopneumonia.

Bronchitis was the most frequent premonitory manifestation. This was noted on the records in 122 cases, next in frequency was sore throat, recorded 65 times. There were, however, many cases where, from apparently good health, the onset was ushered in by a chill. Only 24 cases followed measles.

Acute abdominal pain was noted eleven times and was frequently most difficult to differentiate from appendicitis. An immediate x-ray was often of value, although not infrequently observation for several hours was required in order to establish a diagnosis.

The colored soldiers, while more susceptible to pneumonia, were less susceptible to empyema. At the time of the outbreak of this epidemic there was one full regiment of colored troops from Alabama in camp, having entered in October. March 29th, in the midst of the epidemic, 2900 colored troops from Tennessee were received.

Of all streptococcus pneumonias, 32.3 per cent. developed empyema. Among the white troops it developed in 42 per cent., and in 26 per cent. of the colored pneumonias. The mortality in the colored was 40 per cent. and in the whites 60 per cent. Suppurative processes elsewhere were also less frequent, as suppurative pericarditis occurred only twice in colored soldiers. On the other hand, 19.9 per cent. of colored uncomplicated pneumonias terminated fatally, compared with 10.7 per cent. of the whites.

Apparently the epidemic first appeared among the colored troops. Forty-one of the first 100 cases came from this single regiment, which represented about one-sixth of the total strength of the division. The three other infantry regiments had 17, 14, and 7 cases each. However, the white regiments were not full strength, the total number in the three being approximately 6500, while the colored regiment had slightly over 3600. Studied by companies, these first 100 cases were about equally distributed, no one company showing a marked preponderance of cases. From November 1st to February 23d no large body of new troops entered camp, beginning on this latter date 15,000 northern white soldiers were received. Beginning March 29th 2400 whites and 2600 colored (the latter chiefly from Tennessee), April 26th 10,000 more white troops were received. These were the chief changes preceding and during the epidemic which appeared about March 20th.

Many observers have already called attention to the diag-

nostic difficulties offered in the detection of these pus pockets. The findings at autopsies demonstrated how difficult or perhaps impossible it would be for the clinician to locate these. Even large amounts of free pus, especially early in the epidemic, were overlooked by the medical officers. In some cases it would probably be explained by the rapid accumulation of fluid during the last few hours of life. In others the physical findings were those of a complete or partially consolidated lung, although aspiration demonstrated the presence of an exudate. Apparently no adequate explanation has been made of these misleading physical findings. The x-ray when frequently repeated was of considerable value. The chief reliance, however, was placed upon the character or long continuation of the fever, and the frequent and repeated resort to exploratory puncture. In spite of these various measures, and although the ward surgeon in many cases was practically certain that pus was present, it was not located until autopsy. In 109 empyemas coming to autopsy, undetected pockets of free pus, not recognized clinically, were found in 41 cases. In 18 of these the amount of pus was so small or so deeply located that its recognition would have been extremely difficult. Comparatively large collections of pus were overlooked in 23 cases. On 109 empyemas autopsied, the right side was involved in 37, the left, 42, bilateral, 27, and post-sternal alone in 3.

Exudative pericarditis was found at autopsy 38 times, or in 34.8 per cent. In 17 of these the fluid was definitely purulent. Exudative pericarditis was only found in association with empyema. The empyema was right-sided in 11, left in 16, and bilateral in 11. As previously stated, exudative pericarditis occurred only twice in colored soldiers.

Peritonitis was present in 17 of the 109 empyemas coming to autopsy. It was never present except in association with empyema. The latter was right-sided in 8, left in 5, and bilateral in 4. In 6 of the 17 cases there was a combination of peritonitis, pericarditis, and empyema.

Other complications occurring infrequently were arthritis 8 times, with 4 recoveries, erysipelas 5 times, with 2 recoveries,

acute endocarditis and gangrene of the lung was only found once, suppurative otitis media was quite common, but exact figures are not available.

The mortality in the 164 empyemas developing during the streptococcus epidemic was 61.7 per cent. The combined mortality from uncomplicated pneumonia and empyema was 31.7 per cent.

At the onset of the epidemic, immediately on the detection of a turbid fluid containing streptococci, drainage by rib resection was performed. The results were not satisfactory. Many patients returned from the operating room in a state of collapse from which they did not recover. In their extreme toxic condition, apparently the shock of the operation, and especially the effect on the heart of the artificial pneumothorax was sufficient to at least hasten a fatal termination. After employing this method of treatment for about ten days a change was made to repeated aspirations until the condition of the patient was sufficiently improved to warrant operation. The results from this procedure appeared to be much better, in fact, the improvement was so marked in some of these cases after a few aspirations that operation was delayed, and in 11 cases recovery without operation resulted. It is interesting to note that 6 of these were aspirated only once. It is possible and perhaps probable that these would have recovered without aspiration.

When we compare the mortality results of these various measures, it is found that in 43 cases with early operation 52.5 per cent. died. In 49, with repeated aspirations, then operation, the mortality was 32.5 per cent. In 24 cases where aspiration alone was performed, either because the improvement was so marked that an operation was not considered necessary (this was true in 5 cases) or on account of the gravity of the condition was considered unfit for operation, the mortality was 73.6 per cent. In addition, there was a fourth group of 32 patients who were only aspirated once. Six of these were mild cases, where recovery followed a single aspiration. The others were very grave cases, where death occurred before repeated aspiration or operative measures could be carried out. The mor-

here was 81·2 per cent, or all died except the 6 mild cases referred to. As previously stated, the mortality in all cases of empyema during the epidemic was 61·7 per cent.

One point should be considered in regard to these figures viz, that apparently the virulence of the infection was more marked early in the epidemic. Immediate operative measures were undertaken at the onset of the epidemic, and the mortality during this period was 76 per cent, while immediate operation in May gave a mortality of 28·6 per cent.

Repeated aspiration followed by operation was begun about the beginning of the third week of the epidemic, with a mortality of 39·3 per cent, falling to 28 in May. As seen from these figures, the results of these two procedures were the same in May when the epidemic was dying out. If repeated aspiration followed by operation had been instituted at the beginning of the epidemic it is highly probable that the mortality would still have remained very high, as it was the opinion of the medical officers after the first two weeks that the virulence of the infection was distinctly reduced.

SUBACUTE AND CHRONIC MEDIASTINAL COMPLICATIONS OF MEASLES

BY MAJOR JOSEPH C FRIEDMAN, M C, U S A., and
CAPTAIN WARREN T VAUGHAN, M C, U S A

Camp Sevier S C.

THE acute complications of measles, the bronchopneumonias and empyemas, the sacculated pus formations, found generally at necropsy in the mediastinal region have been frequently enough described in recent literature. The later results of the infection have not been so thoroughly recorded. Among the latter persistent tachycardias (neurocirculatory asthenia?) are worthy of note, and also the type of case to be recorded here.

The first patient, A, twenty-five years of age, a private in an infantry regiment, was admitted to the Base Hospital April 1st. He had had more or less of a cough for some time previous to admission. There had not been anything urgent about this condition and he had not sought treatment for it. His complaint on admission was of a neuralgic pain in the right lower chest quite constantly present, but made distinctly worse on cough and deep inspiration. It was also more severe during the night. This had been present for four days and had been increasing in severity. He felt rather feverish in the afternoon. He had had no night-sweats. The patient is a farmer and denies the use of alcohol. He is unmarried. He had typhoid fever fifteen years ago. Two years ago he had pneumonia and was laid up for two months with it. There is no history of venereal disease. The family history is negative as to pulmonary disease.

On admission he had a few coarse râles at the base of the right lung and moderate right apical fibrosis. The temperature on the first day was 101° F. On the fifth day after admission he developed a typical measles rash. On April 7th the tempera

ture fell suddenly to normal, where it remained for a week, but the chest signs persisted and, in fact, increased. In addition to the bilateral so-called indeterminate râles there appeared fine moist râles distributed in patches. On April 15th he suffered an increase in his pulmonary signs which had nearly cleared up, and a recrudescence of his fever. The leukocyte count rose to 26,000 and a diagnosis of bronchopneumonia was made. During the next twenty-seven days he ran a low grade temperature, with an occasional normal day.

At this point let us discuss in further detail one of the earlier observations made in this patient, namely, his cough previous to entrance. Whether or not this had an etiologic relationship to his bronchopneumonia is a difficult matter to decide. Does a bronchitis, head cold, sinusitis, or postnasal catarrh present before the onset of the measles prodromata predispose the patient to a subsequent bronchopneumonia? Captain Schnabel, who has been interested in this phase of the pneumonia problem, tells us that of 333 patients with measles and bronchopneumonia 55 gave a history of cough, cold, or other respiratory tract infection previous to the onset of the measles prodromata, while of 333 uncomplicated measles cases only 14 gave a similar history. It would thus appear possible that preceding infection predisposes to bronchopneumonia.

We are told from other camps, particularly Funston, Taylor, and Fort Sam Houston, that postmeasles pneumonia occurs as a result of infection with *Streptococcus hemolyticus*, and that if this organism is not present bronchopneumonia is not likely to occur. The man before you has not been infected with *Streptococcus hemolyticus*. The prevailing organism in his sputum is a Type IV pneumococcus which has been recovered repeatedly therefrom. The great majority of our pneumonias have been infected with Type IV pneumococcus. Moreover, we have had but two or three cases of *Streptococcus hemolyticus pneumonia* in this hospital.

Our patient, then, after an attack of measles developed later a bronchopneumonia, and toward the end of the month a new complaint. This consisted of a pain in his left side, increased

on inspiration and more recently localized also under the manubrium. It is worse on deep inspiration. There is some orthopnea, considerable cough, not harsh or brassy and with but little expectoration. The hemoglobin is 65 per cent, the red count 4,440,000. The right pupil is definitely larger than the left and both react normally to light and accommodation. The chest shows nothing particular on inspection other than some dilatation of the cutaneous veins over the manubrium and in the left axilla. The heart findings are of some importance. Two days ago the apex impulse could be felt in the fourth intercostal space just to the right of the sternum. Today it can but barely be felt in this locality. The point of maximum transmission of the heart sounds is to the right of the sternum. Percussion of the cardiac outline shows the left border to be inside the left nipple line and the right border 3 cm. to the right of the midsternal line. The heart is moderately accelerated, ranging from 90 to 100 beats per minute. It is regular. The sounds are of good quality and there are no murmurs or other abnormal sounds either at the apex or at the base.

At the base the retrosternal dulness is distinctly increased to the left. It measures 8 cm. in each of the first, second, and third interspaces. No murmurs are heard. There is neither thrill nor diastolic shock present. The pulses are decidedly unequal, the right being fuller than the left, and at times there is some delay in transmission of the pulse to the left wrist. In the right arm the systolic blood pressure is 110 mm. Hg, the diastolic 90. In the left they are 100 and 78 respectively.

On examining the lungs we find at the right apex the same signs of moderate pulmonary fibrosis that were present on admission. There is also definite impairment in the left apex behind down to the spine of the scapula. Breath sounds are transmitted normally throughout the right chest, but are diminished, almost suppressed, throughout the left lung from apex to base. There is no impairment of resonance to percussion at either base and no evidence of fluid accumulation. No râles are heard today in any portion of the chest, not even after coughing.

The patient is still running some temperature Last night it went to 104° F, the highest that it has been in some time He sweats every night The white count varies from 15,000 to 24,000 and the polymorphonuclear from 73 to 80 per cent. No tubercle bacilli have been found on any of four examinations Routine stool examination for hookworm was negative



Fig 117

We have, then, as signs of pathology in the mediastinum increased dulness, unequal pupils and pulses, asynchronous pulses, dilatation of cutaneous veins, and non-productive cough There is no evidence of aneurysm No murmur, shock, thrill, or tracheal tug The Wassermann reaction is negative The condition, whatever it may be, is relatively acute There is no adenopathy in other regions With this process we have as-

sociated the constitutional signs of pus, a septic temperature sweating at night, leukocytosis, and an anemia.

This case is presented as one of subacute suppurative mediastinitis following measles and bronchopneumonia. The other possible condition present would be a small pocket of pus present in the pleura between the lung and mediastinum.

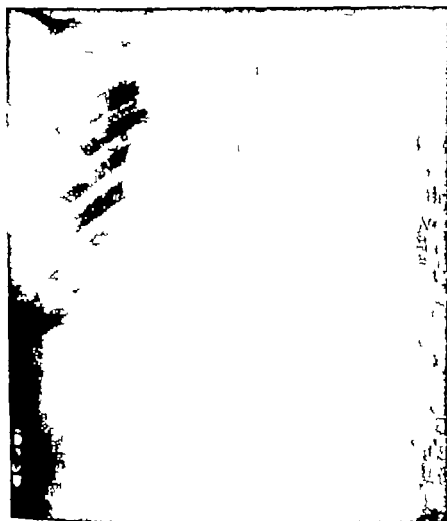


Fig 118.

* Ray examination is as follows. The first plate (Fig 117) was taken shortly after admission to the hospital.

"April 4, 1918. Plate shows some thickening of the hilus shadows, through which are scattered dense round shadows varying from 2 to 8 mm in diameter, probably old calcified tuberculous lesions. Both apices are somewhat cloudy, with increased linear markings extending thereto. Near the right

base there is a large area of dense shadow extending to the diaphragm and apparently involving the diaphragm in adhesions. This shadowing gives the impression of dense fibroid thickening. The findings in this patient are believed to be due to an old tuberculosis, present activity undetermined" (Fig 118)

"April 23, 1918 Right apex clear. Mottling of the right lower lobe, which also presents a homogeneous hazy shadow. Entire left lung cloudy. Small areas of dense consolidation at lower left cardiophrenic angle about the size of an egg. Mediastinal shadow enlarged, giving the impression of a dilated aorta. Impression, generalized bronchopneumonia."

Three physical signs remain to be accounted for. First, the suppression of the breath sounds in the left lung in spite of good percussion resonance, second, the impairment at the left apex, third, the displacement of the heart. The first condition is probably due to pressure on the left bronchus. The apical dulness is a result of decrease in air-containing tissue due to the enlargement of the upper mediastinal tissues to the left. The cardiac displacement is not entirely satisfactorily explained. The next x-ray offers an explanation.

"May 9, 1918 Plate shows apices somewhat cloudy and costophrenic angles clear. The pneumonic process previously described in its base has undergone some resolution. The heart and mediastinal vascular shadows are displaced slightly more to the right than was shown on the previous examination. The inner half of the parenchyma of the left lung and left hilus are obscured by a dense homogeneous shadow, which is greater in area than shown on last examination. Impression, pleural thickening and fluid in the pleural cavity at the inner border of base of left lung which has rotated and displaced the heart to the right" (Fig 119)

If this is the true condition, the diagnosis of acute mediastinitis is in error. The x-ray diagnosis is, however, not absolute. We have had a couple of other cases with loculated empyema next to the mediastinum. This might appropriately be called juxtamediastinal empyema or juxtamediastinal pus. These others did not give pain as the chief symptom. Our man here

complained chiefly of pain, and the distribution is characteristic of that found in acute mediastinitis where it occurs under the sternum and radiates into either shoulder. It may be influenced by change of position.

In any event, the treatment is the same. We shall continue with supportive treatment. Needling is contraindicated at the present time. We will take repeated x rays and as long as the



Fig 119

patient continues in good condition will wait until the pus becomes well encapsulated or an abscess forms. Then will be time enough to consider drainage. Surgical interference in the mediastinum should not be sought at the first opportunity. If he gets worse we will needle him going about the fifth interspace with a small needle, parallel to the spinal column in the hope that we are dealing with a mediastinal empyema.

"July 8, 1918 The general condition of patient A continued to improve, although night-sweats continued for over two weeks and a half The temperature has been normal for many days at a time It has not risen over 99.6° F for over five weeks, except one week, when he developed a tenosynovitis of the right knee "



Fig 120

r-Rays have been as follows—May 21, 1918 Left apex cloudy and right apex nearly clear All angles clear There is increase in each hilus shadow and mediastinal vascular shadows There is an increase in bronchial tracings radiating through parenchyma of both lungs There is a dense shadow homogeneous in character obscuring partially the left hilus This plate compared with the plate made May 9, 1918, shows that resolution has taken place to a considerable degree in both right and left lung, and shows the mediastinal shadows to be less in width

The heart appears either rotated or pulled to the right. It lies in the midline of the thorax. The stomach is distended with gas to an unusual degree (Fig 120)

"June 19, 1918 Both apices fairly clear All angles clear Numerous pea sized calcified areas seen in the region of each hilus, and a few also in the parenchyma of each lung Marked increase in bronchial tracings radiating throughout both lungs



Fig 121

Impression, pneumonic residue Evidence of past lesion, probably tuberculous, which is inactive at this time Marked fibrous change seen throughout both lungs" (Fig 121)

The patient has been up and around for some time and feels well. He does not raise sputum, and he was transferred today to a general hospital

The second patient, B, an infantryman, twenty three years

of age, white, entered the Base Hospital on June 21, 1918. In civil life he had been a farmer. His habits have been good, and the family history is of no importance except for the fact that one brother has tuberculosis (?) of the left arm and leg. The patient denies venereal infection. He has had whooping cough and diphtheria in childhood. He was in this hospital in December, 1917, with measles. In January of 1918 he had an attack of mumps. He has been coughing more or less since the measles attack of last December. In March, 1918, he had an attack of some kind with fever, cough, expectoration, and hoarseness. The sputum was not excessive, but thick, tenacious, and never bloody. During the severe attack in March he had epigastric pain and vomited freely. The patient's appetite has been fair, but he suffers from rather frequent night-sweats. He claims to have lost in all about 40 pounds in weight. At present he complains of some pain under the sternum and in the left axilla and is nauseated at times.

Examination reveals a tall, rather poorly nourished, but fairly well built young man who appears pale and weak. The pupils are regular, equal, and react normally to light and accommodation. There is an enlarged gland in the right supraclavicular fossa, hard, elastic, movable, not tender, and about the size of a small walnut. There are several similar but smaller glands in each of the axillæ. There is no evident adenopathy elsewhere in the supraclavicular region. The pulse is regular, rate 160 standing and 120 lying down. The radial pulses on the two sides are equal. The systolic blood-pressure measures 100 mm Hg, the diastolic 75. Both sides of the chest expand equally. There are no abnormal pulsations in the chest and no distended veins are visible. There is some depression of the supraclavicular fossæ. In both apices there is found dulness, bronchovesicular breathing, and changes in the whispered voice sounds as far down as the second interspace anteriorly and to the tops of the scapulæ posteriorly. Kronig's isthmus is fairly wide and equal at both apices. No râles are audible.

The apex-beat of the heart is diffuse, in the fifth interspace at the nipple line. The transverse diameter of the heart meas-

ures 13.5 cm There are no thrills, murmurs, or accentuations There is some dulness on percussion over the manubrium extending a short distance to either side The abdomen is scaphoid There is no tenderness and no masses in the abdomen The liver and spleen are just palpable Tendon reflexes are normal.

Examination of the larynx by Major Fetterolf showed a paralysis of the left vocal cord which accounts for the patient's persistent hoarseness

An x ray of the chest, taken shortly after admission to the hospital

"Both apices mottled All angles fairly clear Hilus shadows increased There is a soft, moist, flaky mottling through the upper two-thirds of the left parenchyma Similar shadowing in the right parenchyma, though less in degree Between the second and third interspaces anteriorly and just to the right of the spine is a dense homogeneous shadow, 5½ cm long and 1½ cm. wide. In the stereoscope this shadow appears to be posterior to the mediastinal vascular shadow and at the inner border of the right larynx above the hilus x Ray diagnosis (Captain Hawkins) The shadow is probably caused by the thickened pleura at this location The lung changes probably indicate pneumonic residue" (Fig 122)

The gastric analysis, after a test meal, showed nothing abnormal. The Wassermann reaction was negative. No tubercle bacilli could be found in the sputum The patient's red count is 4,800,000 the leukocytes 7000 The differential count shows 8 per cent. of large mononuclears, 24 per cent. of small mononuclears, and 68 per cent. of polynuclear cells His hemoglobin is 68 per cent.

The patient's supraclavicular gland has become decidedly larger since admission On the whole he feels fairly well but somewhat weak He has an afternoon temperature of 99° to 99.6° F and coughs considerably at night but is improving his general condition An x ray of the gastro intestinal has revealed no abnormalities

The diagnosis as to the gross pathologic condition

course, simple. There is pressure on the left recurrent laryngeal nerve. Aneurysm and malignancy are ruled out by the clinical and x-ray evidence. The suggestion of the radiologist that the mediastinal dulness might be due to a thickened pleura following the measles or an overlooked localized empyema is rendered improbable by the signs of present activity, temperature, pain and variation in size in the supraclavicular gland. The only



Fig 122

other possible explanation is pressure from enlarged glands. Thus, of course, accounts for the pressure symptoms, and the fact that it follows measles makes us incline to the belief that it is a simple or tubercular localized adenitis of the peribronchial lymph-glands rather than a beginning Hodgkin's disease. The evidence is not sufficient to diagnose a tubercular adenitis stirred up by the measles, though the suggestive family history, the absence of leukocytosis, and the night-sweats might argue in

favor of that. A simple chronic infection would give the same clinical features

We do not consider removal of the deep cervical gland advisable at the present time because of the patient's evident improvement.

"September 19, 1918 The patient B has improved slightly up to the present time, although there has been no great change

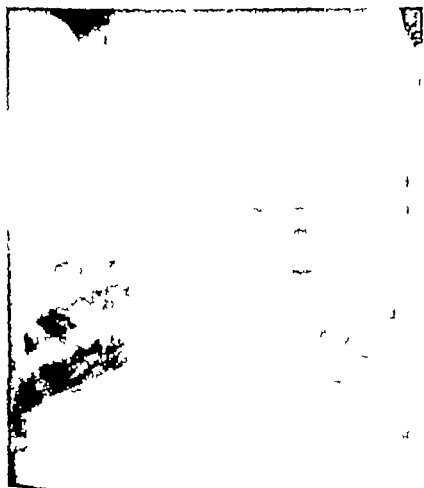


Fig 123

in the clinical condition The hoarseness has persisted The temperature has been normal or essentially so since July 5th, with the exception of the very frequent afternoon rises to 99° or 99.6° F up until August 27th For a week he then ran an afternoon temperature up to 102° F, with normal morning readings. Since that time both morning and evening temperatures have been normal The x ray taken at the beginning of this last febrile period was described as follows

"August 26, 1918 There is a soft flaky mottling, radiating into the apices through the upper two-thirds of each parenchyma. The shadowing is slightly more marked on the right side. Impression, active pulmonary tuberculosis" (Fig 123)

At the time of discharge it is noted that the gland above the right clavicle is slightly larger and that the lung shows no signs of activity other than a few crepitant inspiratory râles in the left lower back and axilla. Otherwise the chest findings are as previously noted. The evidence at hand appears to favor the diagnosis of a lighting up of an old tuberculous activity.

The patient was transferred today to a general hospital.

We have presented the first case because it afforded an unusual opportunity for following a subacute mediastinitis or juxta-mediastinal collection of pus. This second case we present to show the remote results of measles. There are two points we wish to emphasize: first, the very evident rapidity of the pulse on entrance, which continues, though slightly less marked, at the present time. We explain it readily by his slight temperature and the toxemia from the infection of the deep glands. The tachycardia might favor a diagnosis of tuberculous adenitis. Had we found an enlarged thyroid we would have, perhaps, accounted for it on that basis. Had it persisted for some time and a few minor symptoms, such as cyanosis of the extremities, some tremor, etc., been added, and if none of the above causes had been determined, we would have classed this man as a case of neurocirculatory asthenia. It is one of the striking after-effects of measles, at least in adults, that with a temperature that may last only three or four days a tachycardia will so often persist as many weeks or longer, together with perfectly normal subjective condition, or at most a slight feeling of weakness. Whether this may be due in any particular case to myocardial changes or to changes in the specialized tissue of the pace-maker, or to pressure or toxemia from enlarged peribronchial glands, we cannot say except in very pronounced cases such as the present. But we believe that these two patients offer possibilities in the etiologic factors of the effort syndrome which are not being sufficiently considered.

Furthermore, it seems reasonable to suppose that the same toxæmia from the infected glands which produced the tachycardia will produce in the adolescent body every nervous and vascular symptom of the effort syndrome. We believe, then, with those who hold that the effort syndrome or neurocirculatory asthenia means in the majority of cases a slightly damaged heart, following an attack of measles or some other infection. Another point which we wish to bring out is the very slow subsidence of inflammatory processes in the deep glands. When a pharyngitis subsides for a day or two and a recrudescence then takes place, generally one of two things has happened—either we have a direct extension along the mucosa to the larynx, etc., or an extension along the deep cervical glands to those of the chest, and it is these which by pressure cause cough without lung signs and generalized toxic effects. This is a type of focal infection namely, of the deep glands, the existence of which is not often taken into consideration. The nose and throat, the teeth, the prostate, and the uterus are examined because they are accessible, but the deep glands as a cause of chronic systemic disturbance are not sufficiently often thought of. A search for them or even the consideration of the possibility of their existence would probably save some innocent teeth and tonsils.

COMMENTS ON THE METHODS EMPLOYED IN PREVENTING MEASLES COMPLICATIONS

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CONTRARY to past experience in army camps, measles complications have taken the first place as the most dreaded of the mass infections, and naturally the first question raised has been as to the possibility of preventing the spread of the primary disease. That the necessarily rather crude methods available in camps materially limit the extent of measles epidemics has not, we think, been shown. Quarantining of recruits is not logical, for, aside from the mild missed cases turned loose at the end of the quarantine period, those who become infected in the last few days of the isolation will develop the disease after release, and so the epidemic spreads until its virulence is below a certain threshold of infectivity, or the amount of susceptible material is exhausted. Other methods of prophylaxis have not, to our knowledge, been employed. The use of serum from measles convalescents, for example, might have such value.

Statistics as to the suggested use of streptococcus vaccine in measles patients are not yet available. If, however, it is true that streptococcus and pneumococcus pneumonia and empyema are the results of secondary throat infections, and if in measles such throat infections are not acquired at the outset, but later in the course of the disease, then we may hope to accomplish something by the only other practicable prophylactic measure, that is, the separation of measles patients from each other.

Inasmuch as Base Hospitals can control the patients only from the time that they are received in the hospital, the success of the isolation depends on the percentage of such infections

acquired after their entrance into the hospital. Cole and McCallum report that only 11.4 per cent. of their measles cases on entrance gave positive streptococcus throat cultures, which number after one to two weeks' stay in the wards rose to 56.8 per cent. Cumming, Spruit, and Lynch found about 35 per cent. of measles cases to be streptococcus carriers, while Levy and Alexander found 77.1 per cent. carriers on admission. Remembering that an error of 25 per cent. is possible when the conclusions are based on one throat culture only, these variations may perhaps be due to this fact as well as to local differences in the epidemics.

The two latter groups of investigators recommend that all new measles patients be held in one section of the ward until they are identified as clean cases or as carriers, and that they then be segregated. As such identification requires at least eighteen hours, such a method certainly carries with it danger of cross infection during that period. That there is some flaw in our present methods is evident from the work of Levy and Alexander. Segregation as above indicated, using the ordinary means advocated, such as hanging sheets between the beds, masking all attendants, policing the floors, etc., were found by them to be insufficient. In one ward with 15 clean cases, that is, cases with no streptococci in the throat cultures at entrance, and 15 contaminated cases of measles, they found at the end of one week only 6 non-carriers remaining. In another ward of 24 of whom, at the beginning, half were clean and half were carriers, at the end of a week only 3 clean cases remained. Such isolation measures are evidently at fault somewhere.

In deciding on any scheme for isolation we must consider the following possibilities: (1) air-borne infection, distant and near, (2) infection by carriers and by missed cases, (3) infection by contact, either direct or indirect. In the schemes for the prevention of crossed infection in measles so far proposed the first factor enumerated has been reasonably carefully guarded against, the second and part of the third fairly well considered, and the prevention of infection by indirect contact comparatively ignored.

The apparent importance and the demonstrated importance

of these three factors appear to be quite different. Thus the transmission of infection through the air for long distances is now recognized as negligible. The expired air in quiet breathing does not contain bacteria. Only on loud talking, sneezing, and coughing is the air infected, and then it is through droplets of saliva or of sputum of various sizes, the larger droplets which contain by far the largest number of bacteria being carried only short distances, while the smaller droplets, which contain fewer, may be carried to a distance of many feet in all directions. In general, it may be stated that the danger zone is not greater than from 3 to 9 feet around the patient. Infections occurring along a greater radius than this, as, for instance, from one family to another in the same house, are usually traceable to contact infection.

Infection by carriers does not concern us greatly here. It is brought only where nurses or convalescents harbor streptococci in their throats, and presumably the gauze masks are sufficient protection against this. The proof, however, is so far purely empiric. We know of no experimental facts to determine the number of layers of gauze or the fineness of the weave needed to sterilize the air in coughing or sneezing. Infection by direct contact is insured against by keeping the patients apart, but it is the indirect transfer which is so generally overlooked.

This method, to which Grancher and his followers called attention over twenty five years ago, is in need of greater consideration at the present time. It practically narrows down to the transfer by physicians, nurses, and ward men of infected material by their hands, clothing, or utensils. It is evident that in the case of meningococci such transfer must be rapid, as this organism is visible for short periods only outside the living body, but streptococci, with their greater resistance to drying, may carry infection after much longer periods. It has also been demonstrated that pneumococci in dried sputum may live as long as one month. In order to prevent such transfer the principle would have to be adopted of sterilizing every object before it touches the patient and every object which is carried away from him. Infection is carried to the mouth not only

respiration, but probably to a much greater extent by the hands of the patient from his clothes, body, etc. To have a nurse's gown sprayed with sputum while bathing one patient, and then to bathe a second whose hand will quite certainly come into contact with the gown, and subsequently with his lips or nostrils, is surely a possible source of cross infection. The same applies to the basin used in bathing the patient and (what is less frequently considered) to the bed-pan and urinal. Of course, no one would use a thermometer on a second patient without at least the ceremony of disinfection, although the effectiveness of the same is certainly doubtful in many instances. In short, if we wish to avoid cross infection from streptococcus carriers to non-carriers we must isolate each measles patient from every other with the same care that we would use in isolating a scarlet fever from a measles case.

To accomplish this it is necessary to separate the cubicles more effectually than by the sheet method. One has only to see the sheets blown about by the wind or pulled aside by the patients in an attempt to relieve their loneliness to realize their inadequacy. In an attempt to improve on this system we have had light screens constructed consisting of wooden frames, 8 feet long and $6\frac{1}{2}$ feet high, made of 2-inch strips. The foot-rest is 18 inches wide, just enough to furnish adequate support. On the frame is stretched a large sheet of canvas, salvaged from tentage and painted white. It is kept flat by light diagonal wooden strips one on either side. One of the screens is placed on either side of the bed, backed up close to the wall, while along the free ends runs a wire for attaching the sheet, which forms the fourth wall of the cubicle. In very hot weather or after coughing has ceased the sheet may be partially drawn back. The advantage of such a miniature room is not only in the diminution of the danger of droplet infection, but in the increased tendency on the part of the personnel to obey the many rules for isolation.

Were such a course possible the proper method of preventing of infectious material would be to have a separate and complete outfit for each patient, from bed-pan to thermometer,

including stethoscope, and to require the use of rubber gloves in handling patients. As this is obviously not feasible, we have adopted rules carrying out the principles stated above, of which the following were the most important

"Isolated patients shall be confined to the cubicles until considered safe by the ward surgeon. (This would logically be decided by the throat cultures.)

"A gown shall be permanently kept in each cubicle and must be worn by every individual who enters this space except when there is no actual contact with the patient or the bed.

"Individual thermometers, wash cloths basins, towels, and glasses must be kept in each cubicle.

"All dishes must be soaked in lye solution and then in hot water

"Bed-pans and urinals shall be washed in water immediately after being used, and then placed in a large galvanized iron can containing lysol solution for at least one-half hour before being used again.

"Medicine glasses, syringes, and ice-bags must be thoroughly sterilized after each use.

"Water taps and basins in bath rooms should be frequently washed with lysol solution

Finally 'Any individual handling patients must wash his hands in lysol solution after touching a patient or any article which has come in contact with him.

The remaining rules were the usual ones in force in contagious wards.

Of course, such a régime necessitated a slightly more numerous personnel, but, above all, a more constant one. Frequent changes are inimical to any success in handling contagious diseases. But it is possible that the lack of such detailed care is at the bottom of the failure of the ordinary methods of isolation.

A further advantage of the isolation of every case is that preliminary throat culture is rendered unnecessary and the dangers arising even from eighteen- to twenty-four hour contact of clean with dirty cases are avoided. Furthermore, in the case of a mistaken diagnosis a patient may be withdrawn from such a cubicle, if the rules have been observed, without having been exposed to measles, though points of contact at time of entrance and discharge from the hospital and from the ward must be looked for and eliminated. It is a question of eternal and intelligent

vigilance Of course, a minor blunder nullifies an enormous amount of painstaking care

The only opportunity that we have had of testing the results of this application of Grancher's medical antisepsis was in the early summer The measles cases increased considerably with the influx of new troops, but bronchopneumonia was so infrequent that reliable statistics could not be obtained We did, however, take throat cultures of cases within and without the cubicles at intervals, for comparison Cultures from 20 patients kept in isolation as strict as possible gave the following results

Twelve, or 60 per cent, had pneumococcus Type IV at entrance Three more, or 15 per cent., had Type IV at second or third culture, which were taken at five-day intervals, but not at entrance Eleven, or 55 per cent., had Type IV on two or more cultures Pneumococcus Type I was found twice Streptococcus, hemolytic or non-hemolytic, was found on entrance three times, or in 15 per cent. On second or third culture two more, or 10 per cent, were positive No complications occurred among these patients These do not, of course, include by any means all the patients kept in cubicles, but only those from whom we took the routine cultures described As a matter of fact, there was a case of bronchopneumonia in a cubicle patient, but not of this group

Single or multiple cultures at five-day intervals were taken from patients in the open ward, separated by sheets, in 28 cases Of these at entrance, 18, or 71 per cent, showed pneumococcus Type IV Of 12 cases of which three or more cultures were taken at five-day intervals, Type IV pneumococcus was found in 8, or 67 per cent On second or third culture but not on first it was found twice more, or in 16 per cent. Streptococci were not found at entrance in any of these 12 cases, but were found on second or third culture three times, or in 25 per cent. Complications occurred six times, or in 21 per cent., of the whole 28 cases, including 1 tonsillitis, 4 otitis medias, and 1 bronchopneumonia

As stated above, the series is not large enough to warrant conclusions Worth noting is the small number of streptococcus

carriers, which corresponds with the fact that in the severe winter epidemic at this camp the pneumonias and empyemas were not due, as a rule, to streptococcus, but generally to pneumococcus, contrary to the experience in many camps. The question, then, of the value of medical antisepsis in preventing measles complications cannot be answered, but we did find that it does not involve impossible demands on either personnel or property, though calling for a slight increase in number of the former.

Another very pressing need was answered by such movable cubicles, and that was for isolation rooms for suspects of various sorts in times of epidemics. By having extra cubicles in each general ward we were able to isolate every fever case sent in until the diagnosis was established, when, if the above precautions had been observed, the patient could either be moved into the ward or sent to a contagious ward. The danger to the hospital and to the patient is less than in an observation ward as ordinarily conducted.

CONCLUSIONS

- 1 At present in considering the prevention of measles complications, while emphasis is rightly laid on direct transmission through droplet infection, the indirect means, through attendants, utensils, etc., is being unduly neglected.

- 2 A more complete method of isolation, that of Grancher, adapted to military needs, has been tried, and while no statistical proof can be adduced, there seems to be a diminished number of complications in the properly isolated case.

- 3 These screens can also be used to advantage in doubtful cases of contagious disease in general medical wards.

PNEUMONIA AND EMPYEMA AT CAMP UPTON N Y

BY MAJOR RUSSELL L CECIL, M C , U S A

DURING the past year the chief medical problem in the American army has been pneumonia. The collection into crowded tents and barracks of large bodies of men, many of whom were in poor physical condition, furnished excellent opportunity for the dissemination of various infectious diseases. First came the commoner contagious diseases, such as measles, mumps, and German measles, and it was soon observed that recruits from country districts were more susceptible to these infections than men from the city. This was particularly true in the case of the pneumonia which often followed measles. The men who composed the 77th Division at Camp Upton were drafted in great part from cities, and proved no exception to the rule that city men endure the overcrowding and exposure incident to camp life better than men from the country and smaller towns.

In any discussion of pneumonia as seen in the American cantonments it is necessary at the outset to differentiate the disease into two types, which might almost be said to be two different diseases, namely, lobar pneumonia, usually of pneumococcus origin, and bronchopneumonia, usually of streptococcus origin. Lobar pneumonia in the camps has differed in no respect from that seen in civil life. The disease, as a rule, ran a comparatively mild course, and the mortality rate has been distinctly lower than that of the average city hospital. The streptococcus pneumonias, on the contrary, have presented an unusual clinical picture, have run a severe course, and the mortality rate has been high.

The autumn of 1917 proved to be a most healthy season at Camp Upton. Up to December 1st scarcely more than a dozen pneumonias were admitted to the Base Hospital. Without ex-

ception these were pneumococcus infections of the lobar type and ran a very mild course. On Christmas Day, 1917, the first case of streptococcus pneumonia was admitted to the Base Hospital. This patient had just arrived from Fort Slocum, and gave a history of being taken ill just before leaving that post. The hemolytic streptococcus was found in his sputum. Two other hemolytic streptococcus cases were admitted shortly after, both colored men. One had been transferred from Camp Lee and the other from Camp Pike. These cases marked the beginning of streptococcus pneumonia at Camp Upton, and it became more and more prevalent as the winter advanced, so that by spring the majority of pneumonias admitted to the Base Hospital were of streptococcic origin. The negro troops were particularly susceptible to streptococcus pneumonia. While they constituted only about 10 per cent. of the average strength of the camp, they contributed more than 50 per cent. of the streptococcus pneumonias.

A number of other cases of streptococcus pneumonia occurred among the negro troops who were transferred from Camp Pike to Camp Upton, and as streptococcus pneumonia was quite prevalent at Camp Pike during this period, there seems no reason to doubt that these colored troops were instrumental in introducing the hemolytic streptococcus at Camp Upton, and were responsible for the epidemic of streptococcus pneumonia which followed. Furthermore, it may be said that the wide distribution which this virulent organism achieved was almost certainly due to the indiscriminate transportation of troops from infected camps into the various other camps all over the country. It is probable that if these infected negroes could have been kept out of Camp Upton pneumonia would have contributed a comparatively unimportant part in the camp morbidity, and that we would have been able to maintain throughout the year the remarkably low morbidity rate of the autumn months.

However, the hemolytic streptococcus, having been introduced into Camp Upton, gradually spread throughout the various organizations until streptococcus pneumonia assumed rather large proportions during March and April. Up to

February 1st pneumococcus infections had predominated, but from February 1st to the present time the cases of streptococcus pneumonia have outnumbered the pneumococcus cases

Captain H F Vaughan, the Camp Epidemiologist at Upton, has shown quite clearly on charts the importance of weather conditions as a predisposing factor in pneumonia. Captain Vaughan's charts show that there were two distinct periods of increase in the incidence of pneumonia at Camp Upton. The first up-wave consisted of pneumococcus infections, and occurred in December and early January, following the arrival of colored rural troops from the South. These men had been in the service only six weeks and were unaccustomed to the hardships and exposure of military life. It happened that this was a period of thaw, accompanied by heavy rainfall. The men frequently got wet, and this, together with the other conditions, led to the increase in pneumonia. In March there was another thaw, and by this time the hemolytic streptococcus had become well disseminated throughout the camp. This was shown by the throat cultures taken from a considerable number of troops at this time. The March thaw was accompanied by a marked increase in the incidence of pneumonia, mainly of the streptococcus type. There was also an epidemic of influenza and bronchitis in camp at this time.

The pneumonias which have occurred at Camp Upton during the past winter and spring have been studied with particular care, and an effort has been made to secure accurate sputum examinations in every case. During the early part of the season, before the Base Hospital was opened, bacteriologic examinations were not possible, and again, later on in the spring, when sometimes 15 or more pneumonias were admitted to the hospital in one day, a number of the cases escaped sputum examination. With these exceptions, however, practically every case of pneumonia admitted to the hospital received a bacteriologic examination of his sputum. In a large number of cases the sputum examination was made by two or three different methods, and in some instances repeated specimens were examined with the idea of detecting changes in the character of the infection if

such occurred. Special attention was devoted to the collection of the sputum. At the beginning we tried to have this done by the nurses and orderlies, but it was soon found that they were not sufficiently careful to obtain the proper kind of specimen. It was decided, therefore, that every sputum should be collected by some member of the laboratory staff. In the cases where the patient was unable to cough when requested a sterile Petri dish was left by the bedside, with instructions to the patient to expectorate into the Petri dish when he was able. By using this method we were fairly sure that the specimen came from the chest and not from the nasopharynx.

After the sputum had been thoroughly washed smears were made for Gram and capsule stains, and an emulsion of the sputum in salt solution was then prepared in the usual manner.

Three methods of sputum examination have been employed: (1) inoculation of mouse, (2) Avery's blood broth method, (3) direct culture of emulsified sputum on blood-agar plates. In a large number of cases two or more of these methods have been used on the same sputum in order to check up the accuracy of the methods and to give us increased confidence in the bacteriologic findings.

From October 1, 1917, to August 1, 1918, 423 pneumonias were admitted to the Base Hospital at Camp Upton, 382 of these had one or more bacteriologic examinations made on the sputum. In 41 cases the sputum was not examined. The following table shows the number of times each method was used.

1 Mouse alone	98
2. Blood broth alone	158
3 Mouse and blood broth	75
4 Blood broth and direct culture	27
5 Mouse and direct culture	1
6 Mouse, blood broth, and direct culture	15
7 Direct culture alone	8

Of the 382 cases of pneumonia in which bacteriologic examinations were made on the sputum, 161 were of pneumococcus origin and 182 of streptococcus origin (see Table I). In other words, the pneumococcus and streptococcus played an almost equal

part, numerically, in the etiology of pneumonia. There were 6 cases in which the *Bacillus influenzae* was the predominating organism, and 6 others in which the *Micrococcus catarrhalis* was apparently the causative agent. There was 1 case of *Staphylococcus aureus* pneumonia, and, finally, there were 26 cases of mixed infection in which the pneumococcus and streptococcus were both found.

Table II shows the incidence of the various pneumococcus types. It will be seen from this table that the Type IV pneumococcus was by far the most prevalent of the four types, occurring more frequently than the other three types combined. One reason for this was undoubtedly the extensive use of pneumococcus vaccine against the first three types. This subject will be referred to later. Type IV pneumococcus was, however, the most common type even before the vaccine was instituted, and the same predominance of Type IV has been observed in a number of other camps. At one time it was feared that there was some fault in our method of typing sputa, but when we found Type IV pneumococcus in the pleural fluid of 6 cases of Type IV that developed empyema, and when, furthermore, Type IV pneumococcus was recovered in a number of instances from the lungs at autopsy, we were forced to conclude that our examinations were, for the most part, accurate.

Clinically, the Type IV cases ran a mild course, showing a mortality rate of only 16.3 per cent. The Type I pneumonias gave a mortality of 13.8 per cent., and if those cases that did not receive serum be excluded, the mortality in this group was only 10 per cent. The Type II pneumonias showed the highest mortality, 33.3 per cent., while the Type III cases, with a mortality rate of 23.1 per cent., ran a considerably milder course than those seen in civil life. The pure pneumococcus infections were almost without exception primary. Only 13 cases followed measles, and there were a few cases which came on after an attack of influenza. Most of these cases presented the classic picture of lobar pneumonia, i. e., the type of pneumonia usually seen in civil practice. There were a few cases of central pneumonia, and in some of the mixed infections patches of broncho-

pneumonia could be demonstrated by *x*-ray or autopsy in addition to the lobar consolidation

Complications were comparatively rare in the pneumococcus infections. Empyema was the commonest complication and occurred 27 times in this series. In 16 of these the pneumococcus was recovered from the pleural exudate, and in 11 the streptococcus was found. In 10 cases other cloudy or seropurulent fluid was removed from the chest, the cultures from which were sterile.

Pneumococcus empyema usually develops late in the course of the pneumonia when the patient is convalescent. There is a sudden rise in temperature and a corresponding increase in pulse-rate. Frank signs of fluid are usually present, and upon exploring the chest over these areas cloudy or purulent fluid is withdrawn, which on examination shows many pus-cells and capsulated pneumococci.

Pneumococci of Types I, II, and IV are all represented in this group of empyemas, and in all except one case the same type of pneumococcus was found in both sputum and pleural exudate. Of this group of 27 empyemas, 12 died, a mortality rate of 44.4 per cent.

A majority of the pneumonias which have occurred at Camp Upton during the past ten months have been of streptococcus origin, and these cases have excited more interest than the pneumococcus cases (1) because of their comparative rarity in civil life, (2) their unusual bacteriologic picture, (3) the frequency of empyema as a complication, (4) their higher mortality rate.

These cases also differ from pneumococcus cases in that they are frequently secondary to some other infection—23 of the streptococcus cases followed measles, 5, mumps, 1, German measles, 3, scarlet fever, 12, influenza, or some other infection of the upper respiratory tract. In other words, less than 75 per cent. of the streptococcus pneumonias were primary infections, and it is probable that if more careful histories could have been obtained a still larger percentage of these cases would have proved to be secondary infections.

At the outset it is necessary to divide the streptococcus pneumonias into two groups (1) the hemolytic streptococcus pneumonias, (2) the non hemolytic streptococcus pneumonias (see Table III)

One hundred and eighteen pneumonias in this group, or 64.8 per cent., were due to *hemolytic* streptococcus. This is the type of pneumonia which has been so frequent in the various cantonments during the past winter, and which has been described by a number of writers.¹ These cases present a fairly definite and characteristic clinical picture. The patient who often gives a history of some recent infection of the upper respiratory tract is admitted to the hospital complaining of cough, fever, and frequently pain in the side. The onset, as a rule, is gradual, though it may be very sudden. Many cases are admitted with a diagnosis of influenza or bronchitis. The cough, in the beginning, is dry in character and often absent, a feature which makes it difficult or impossible to collect a satisfactory specimen of sputum. The sputum itself is rather characteristic. It is usually a white or yellowish color, quite viscid and mucopurulent. The typical rusty or hemorrhagic sputum of lobar pneumonia is uncommon. In 118 hemolytic streptococcus cases, 89 showed mucopurulent sputums and 29 showed rusty sputums. Pain in the side is a fairly constant symptom and was present in 62 per cent. of the cases.

The physical signs in this type of pneumonia are often indefinite. One of the most characteristic features is the marked prostration which is usually present. The patient appears markedly exhausted. Cyanosis is usually noted, but there is not the marked dyspnea and expiratory grunt so often seen in lobar pneumonia. Profuse sweats very frequently occur, while chills are comparatively rare. Areas of dulness can often be made out, but are usually circumscribed. Moist, crackling

¹ Alexander H. A. Jour Amer Med Assoc. 1918, lxx, 775-776. Cecil, R. L., Austin, J. H. Jour of Exper Med. 1918 xxviii 1-9. Cole R. MacCallum W. G., Jour Amer Med. Assoc., 1918, lxx, 1147-1156. Cummings, J. C., Spruit C. B., Lynch, C. Jour Amer Med. Assoc., 1918 lxx 1066-1070. Fox H., Hamburger W. W. Jour Amer Med Assoc., lxx 1753-1760. Lucke B. Jour Amer Med. Assoc., 1918 lxx, 2006-2011.

râles are nearly always heard, but typical bronchial breathing and voice are rather unusual signs at the onset of the disease. Quite often the voice and breath sounds are faint

Diagnosis—This can usually be made without much difficulty by anyone familiar with this type of pneumonia, but under all circumstances the x-ray is of great value in confirming the diagnosis. x-Ray examinations in these cases show many small patches of consolidation scattered usually throughout both lungs, sometimes only one. It is quite common in x-ray plates to find large patches formed by the coalescence of a number of small patches, and sometimes this union produces a picture which simulates lobar consolidation

Hemolytic streptococcus infections almost invariably run a severe course, chiefly on account of the high frequency of complications. The temperature is of a septic type—irregular—like that seen in streptococcus septicemia. Strange to say, however, the blood-culture is usually sterile. Blood-cultures taken in 47 cases gave 10 positive results. Of these, 6 proved to be fatal. The pulse tends to become more rapid as the disease progresses. These patients waste rapidly, and a high calory diet has recently been recommended to combat this symptom.

In 53 uncomplicated cases the mortality rate was 11.3 per cent.

Complications of one kind or another occurred in 65 of the hemolytic streptococcus cases. By far the commonest of these was empyema, which was demonstrated in 41 out of 118 straight hemolytic streptococcus pneumonias. In a series of mixed infections there were 10 hemolytic streptococcus empyemas, and the hemolytic streptococcus was found in 8 cases in which, for some reason, the sputum was not examined. It is fairly safe to assume that all of these were cases of hemolytic streptococcus pneumonia. Summarizing, then, we may say that out of 118 hemolytic streptococcus cases, empyema was demonstrated in 50 per cent.

This complication has been responsible in a great measure for the high mortality which has accompanied this type of pneumonia. Indeed, streptococcus empyema has become such a problem in the American cantonments that a special board has been

appointed by the Surgeon General to study the disease and to determine, if possible, the most successful type of treatment.

One of the most striking features of streptococcus empyema is its early appearance. In many cases the patient is discovered with a chest full of cloudy fluid at the time of admission to the hospital. In the series of cases of empyema studied by Brooks and Cecil a positive diagnosis of empyema was made on an average of 5.4 days after admission to the hospital. The early appearance of empyema may completely mask the underlying bronchopneumonia, and the claim has been made by good observers that streptococcus empyema can develop without any preceding pneumonia.

The diagnosis of this complication is often difficult because of the vague and indefinite physical signs. With the formation of pus there is usually a perceptible increase in the respiratory rate, but the temperature and pulse curve show no change. The classic signs of empyema may be entirely absent. Breath and voice sounds and tactile fremitus may be transmitted through massive exudates with great distinctness. The physical sign which is perhaps the most valuable in the detection of these effusions is alteration of the percussion note. Skin tenderness is observed quite frequently over the affected side and has come to be looked on as quite characteristic. Skodaic resonance has been noted in many cases and is a valuable sign when present.

The x-ray is of great value in the diagnosis of empyema and should be employed as a routine measure in all cases of hemolytic streptococcus pneumonia. If fluid is present in any considerable degree, it will be demonstrated, almost without exception, by a good roentgenologist. In all cases of doubt the hypodermic needle should be resorted to, and should be used freely. The pain caused by this diagnostic method is so slight that the patients do not object to frequent taps.

Character of Empyema Fluid—The pleural exudate, when removed, is usually light yellow, often with a greenish tinge, and in the early stages is only slightly cloudy. Later in the disease it may take on a distinctly purulent character. Smears from the fluid show pus-cells in large numbers, and large round

or slightly flattened cocci arranged in short chains of two to ten organisms. We have observed that the bacteria are much more numerous in streptococcus empyema than in pneumococcus empyema. Cultures from the exudate on blood-agar show after twenty-four hours' incubation many small, moist, elevated opaque colonies of a pearl gray color, each surrounded by a wide and sharply defined zone of hemolysis. Subcultures in blood broth produce clouding of the media with a heavy sediment in the bottom of the tube. Rapid destruction of the blood-cells takes place and the blood broth takes on a brilliant claret red color. Smears from the blood broth show chains of cocci similar in all respects to those seen in the smears from the pleural exudate.

The mortality rate of this type of empyema was very high not only in this camp, but in other camps where the complication was prevalent. Of the 55 cases in our series, 31 died, a mortality rate of 56.4 per cent.

Other complications. Next to empyema, the most common complication in this type of pneumonia is pericarditis. Fibrinopurulent pericarditis has occurred in 6 of our hemolytic streptococcus cases, in all but one case being associated with empyema. This is a very serious complication and develops usually by direct extension of the pleural infection into the pericardial sac. Other complications which have been noted in the hemolytic streptococcus pneumonias are acute general peritonitis, 1, abscesses in lung, 3, parenchymatous nephritis, 2, otitis media, 5, meningitis, 2, peritonsillar abscesses, 4, septicemia, 1, acute fibrinous pleurisy, 3, cardiac dilatation, 1.

Non-hemolytic Streptococcus Pneumonia—There were 64 cases of non-hemolytic streptococcus pneumonia, 35.2 per cent of the total series. This type of pneumonia is very similar pathologically and clinically to the hemolytic streptococcus variety, but runs a much milder course. Complications are not so frequently encountered. A diagnosis of the non-hemolytic streptococcus pneumonia was always made by the method of exclusion, *i. e.*, after the pneumococcus, hemolytic streptococcus, or other virulent organisms had been excluded. The constant

presence of this organism in the normal saliva causes it to be a very frequent contamination in sputum examinations, and it was not accepted as an etiologic factor except in those cases where a satisfactory sputum was obtained. In a number of these cases the bacteriologic diagnosis was substantiated by obtaining the same organism from a complicating empyema, or from the lung at autopsy. Non hemolytic streptococcus pneumonias have not been reported as prevalent in any of the cantonments except Camps Wheeler and Shelby. Zingher has recently described an epidemic of non hemolytic streptococcus empyemas which occurred at Camp Shelby. The organism he described agrees in every way with the type which we usually found in our cases at Camp Upton.

These cases usually ran a mild and short course unless complications set in. The mortality rate in the uncomplicated cases was only 4.3 per cent., which is much less than for any other type of pneumonia. Even when the cases with complications are included the mortality rate is only 9.3 per cent. In some of the cases the disease ran such a mild course that the diagnosis could not have been made without the confirmation of the x ray.

Complications.—The most common complication in this group, as in the hemolytic streptococcus group, was empyema—7 out of 64 cases developed empyema, an incidence of 10.9 per cent. The mortality rate for the empyemas of this group was 57.1 per cent. Other complications were rare. Pericarditis occurred 4 times, meningitis, 1, otitis media, 3, chronic glomerular nephritis, 1, acute fibrinous pleurisy, 1.

Pathogenesis.—The question of ward infection in pneumonia—that is, whether patients suffering from pneumonia of whatever type are likely to contract a streptococcus infection from their associates in the ward or from streptococcus carriers—receives some confirmatory evidence from the fact that our groups of cases include 11 incidences in which a pneumococcus infection of the lungs was associated with a streptococcus empyema. The likelihood of an autogenous infection from streptococci already in the mucous tract of patients when they contract pneumonia seems probable in some cases. This theory

has received some support at Camp Upton from a series of cultures made during an epidemic of streptococcus pharyngitis in the course of which a number of streptococcus pneumonias developed. Cases of pneumonia followed by empyema and all apparently inaugurated by a preliminary pharyngitis are found on our lists.

Pathology—Of our streptococcus pneumonias, 29 came to autopsy—23 of these were hemolytic streptococcus cases and 7 were non-hemolytic cases. Pathologically the two groups are indistinguishable. Of the 29 cases that came to autopsy, 18 cases were frank bronchopneumonias and 11 were of the lobar type. Of the latter group 3 were mixed infections, and the presence of a pneumococcus probably accounts for the lobar pneumonia.

The pathology of streptococcus pneumonia has been recently described by MacCallum and others. Streptococcus pneumonia is essentially a bronchopneumonia, in that the lesions are nearly always limited to the neighborhood of the bronchioles. In some severe cases the infection may be so extensive that the process in the gross resembles a lobar pneumonia, but microscopic examination will show that even in these cases the consolidation is patchy, not massive, as it is in lobar pneumonia. MacCallum has described peculiar and rather characteristic changes in hemolytic streptococcus pneumonia. He speaks of this type of pneumonia as an "interstitial" pneumonia because the changes are chiefly in the interstitial tissue rather than in the alveoli. At autopsy the lungs appear nearly always atelectatic as a result of the empyema usually found in fatal cases. This compression is even more marked if thoracotomy has been performed and a pneumothorax established. The surface of the lung is covered with a thick yellowish membrane of fibrin which is peeled off with difficulty. On section the cut surface is congested and edematous. The bronchioles stand out with remarkable distinctness and are usually filled with pus. The walls of the bronchi appear thicker than normal and there is an overgrowth of fibrous tissue throughout the organ which accentuates the fibrous trabeculae. Thickening about the bron-

chioles may be so marked as to give them the appearance of small tubercles. In fact, the diagnosis of miliary tuberculosis was made in a number of earlier cases. Combined with these changes one may find the typical small grayish elevated patches of bronchopneumonia, and these latter may be so extensive that the picture simulates in a rough way that of lobar pneumonia. Microscopic sections of the lungs in these cases show an extensive infiltration of lymphoid cells about the bronchioles and blood vessels. The epithelial lining of the bronchiole in many cases has been destroyed and replaced by granulation tissue. This inflammatory reaction shows itself throughout the entire wall of the bronchiole, and the young vascular granulation tissue which has replaced the alveoli immediately adjacent to the bronchiole accounts for the small tubercle-like bodies which are seen in the gross examination of the lung. In some places the process has been limited to the bronchioles, so that the process could be well designated as "acute bronchiolitis." In other places, however, the alveoli in the neighborhood of the bronchiole are filled with an exudate of polymorphonuclear leukocytes and lymphoid cells suspended in a network of dense fibrin. This exudate shows a marked tendency to organize, and in some instances the complication of atelectasis and organization of the exudate so completely transforms the normal architecture of the lung that one could almost be excused for not recognizing it as pulmonary tissue. Another characteristic of the infection is the formation of small biliary abscesses. The bronchioles already filled with pus lose their mucous membrane and the overgrowth of granulation tissue occludes the lumen, with the production of circumscribed foci of infection. These small miliary abscesses may occur in large numbers and offer one of the most plausible explanations for the frequency of empyema as a complication.

When suppurative pericarditis develops in these cases it is almost always associated with empyema, and the character of the fluid and the general appearance of the fibrous exudate on the pericardium are almost identical with the fluid and exudate in the pleura. They are, in fact, one and the same process

Changes similar to those described by MacCallum have been noted by Lucke at Camp Taylor

The treatment of pneumonia at Camp Upton can be described very briefly. The lobar pneumonias were treated just as they would be in civil practice. Where circumstances will permit the patients are placed in the open air. As a rule, digitalis is given freely in the early stages, and camphor, adrenalin, and caffeine are administered as symptoms indicate. The usual attention is given to elimination and the temperature is controlled, at least in part, by hydrotherapy. Where the pain is severe or where the cough is troublesome, codein or morphin is used in moderate doses. In 20 cases of Type I pneumonia Type I antipneumococcus serum was employed, with excellent results. The technic recommended by Avery, Chickering, Cole, and Dochez has been faithfully followed. As soon as the diagnosis of pneumonia was made the patient immediately received $\frac{1}{2}$ c.c. of normal horse-serum subcutaneously. If the case proved to be a Type I infection, the patient at once received antipneumococcus serum intravenously, usually 90 to 100 c.c. The first 10 c.c. were allowed to run in very slowly in order to guard against any symptoms of anaphylaxis. The injection of the serum was followed almost immediately by a sharp rise in temperature amounting to 1 or 2 degrees. This was followed by a sharp drop of several degrees, which was sometimes very striking. The temperature usually rose again, but by repeating the intravenous injection of serum every twelve hours the temperature was usually brought down permanently by the second or third day after the initiation of treatment.

Thirty-five cases of pneumococcus Types II, III, and IV pneumonia were treated with a polyvalent antipneumococcus serum which had been sent to us in the early fall by the government for trial. This serum produced a drop in temperature very similar to that observed with Type I serum, and in some instances it seemed to exert a beneficial effect on the patient. The mortality rate, however, in this series of cases (37 per cent) does not indicate that the serum possessed any curative value. It has, therefore, been discontinued.

Two cases of anaphylaxis occurred among our serum treated cases. The first case was that of a young negro who had pneumococcus Type III pneumonia following measles. A desensitizing dose of 1 c.c. of normal horse-serum was given, and this was followed two hours later by 100 c.c. of polyvalent antipneumococcus serum intravenously. Five minutes after the injection acute anaphylactic symptoms developed—intense dyspnea, restlessness, weakened pulse, and relaxation of the sphincters. The symptoms gradually passed away after fifteen minutes and the patient made an uneventful recovery.

The second case was that of a young man with pneumococcus Type III infection, but of a much more severe character than that just described. An injection of 100 c.c. of polyvalent antipneumococcus serum produced a temporary drop in temperature. No other serum was administered until seventeen days had passed, when the patient had a relapse and the ward surgeon requested another injection of serum. The desensitizing dose was given at noon, and the injection of the antipneumococcus serum was started at 3 00 P. M. When 50 c.c. of serum had been administered the patient suddenly exclaimed that he could not breathe, and became very cyanotic. In spite of artificial respiration and stimulation the patient died in a few minutes.

Prophylaxis Against Lobar Pneumonia—Pneumonia is coming to be looked upon more and more as a contagious disease. If it is such, every patient suffering from this disease should be isolated as soon as possible and his contact with other individuals reduced to a minimum. Steps should also be taken to protect the community against pneumonia carriers. These individuals are a constant source of danger. The control of healthy carriers, however, is one of the most difficult problems which a sanitary officer has to contend with, and one which has not yet been satisfactorily solved.

The success of prophylactic vaccination against typhoid fever naturally suggests an effort to combat pneumonia with the same method. Animal experiments have shown that it is easy to produce active immunity by an injection of small doses of dead pneumococci. This immunity lasts for a considerable

time and the good results obtained by Lister in vaccinating miners against pneumonia in South Africa moved us to undertake vaccination against pneumonia at Camp Upton. In some preliminary experiments on volunteers at the Base Hospital it was shown by study of the agglutinations and protective power of the serum in 42 persons vaccinated against pneumococcus Types I, II, and III that a definite immune response could be secured against Types I and II by moderate sized doses of vaccine administered subcutaneously. Little evidence of an immune response to Type III could be determined by this method, but too much significance should not be attached to this, as it is relatively difficult to obtain antibodies in the serum against this strain, even though a considerable degree of active immunity may have been produced in the vaccinated animal.

At Camp Upton 12,519 men were vaccinated against Types I, II, III. Three or four doses were given at intervals of five to seven days, with the total dosage of 6,000,000,000 to 9,000,000,000 for Types I and II, and 4,500,000,000 to 6,000,000,000 for Type III. The local reaction varied greatly in different individuals. The vaccinated men were under observation for ten weeks after vaccination. During this time no case of pneumonia of the three types occurred among the men who had received two or more injections of the vaccine. In a control of approximately 20,000 men there were 26 cases of pneumococcus Types I, II, and III during the same period. The incidence of pneumococcus Type IV pneumonia was much lower among the vaccinated troops than among the unvaccinated. As a result of these investigations it is apparent that vaccinations against pneumonia gave satisfactory protection against the types which composed the vaccine.

The duration of the immunity has not yet been determined, but protection is probably obtained for six to twelve months. Pneumonia vaccine will be used extensively in the American army during the coming winter.

Treatment of Streptococcus Pneumonias —The treatment of streptococcus pneumonia is expectant and differs in no essential way from that of the pneumococcus cases. As yet no serum has

been devised for the treatment of these cases. The prophylactic treatment in this connection consists in protecting patients with measles and other infections from hemolytic streptococcus carriers. This is particularly true in the case of measles. Every patient with measles should have a throat culture immediately on his arrival in the hospital, and all those cases in which hemolytic streptococci are present should be placed in a separate ward. The plan of separating pneumonia patients by means of cubicles has a good rational basis, and undoubtedly prevents many mixed infections.

Treatment of Empyema.—This is the most important problem in connection with streptococcus pneumonia, for the high mortality in this type of pneumonia has undoubtedly been due to the frequency of a complicating empyema.

In ordinary empyema of pneumococcus type an early operation is indicated. In the usual run of cases operation is followed by prompt improvement and eventful recovery of the patient.

The streptococcus empyema problem is quite different. A review of cases of empyema operated on in the Base Hospital at Camp Upton, N. Y., shows that those cases operated on early have almost always died, while those in which the operation had been postponed until the pus had become thicker and well walled off, usually recovered. In the latter group, of course, frequent aspirations were done to relieve pressure in the chest. It seems reasonable to suppose that when the pleural cavity is drained during active bronchopneumonia the rapid collapse of the diseased lung on the side operated upon throws an added strain on the already weakened heart, and for this reason is often instrumental in hastening the patient's death. By postponing operation, however, until the pneumonia has begun to resolve the heart has a chance to adjust itself to the extra strain, there is less toxemia, and the lungs are in better condition when the operation is finally performed. When the patient does come to operation the drainage of the empyema cavity should be complete and continuous, and Dakin's solution should be used in cleansing and disinfecting the cavity. An excellent review of the treatment of empyema is found in a recent number of the

Journal of the American Medical Association by the Empyema Commission situated at Camp Lee, Virginia This report goes into the treatment of empyema at great length and gives full instructions as to how Dakin's solution should be employed in the disinfection of an empyema cavity This phase of the question, after all, is a surgical problem, and I will, therefore, leave it to my surgical colleagues for proper solution

TABLE I
CLASSIFICATION OF PNEUMONIAS

	Incidence.	Percentage.	Mortality	Percentage.
Pneumococcus	161	42.1	29	18.0
Streptococcus	182	47.6	47	25.8
Bacillus influenzae	6		0	
Micrococcus catarrhalis	6		0	
Staphylococcus aureus	1		0	
Mixed infections (pneumococcus and streptococcus)	26	6.8	7	26.9
	<hr/> 382	<hr/>	<hr/> 83	<hr/> 21.7

TABLE II
INCIDENCE OF PNEUMOCOCCUS TYPES

	Incidence.	Percentage.	Mortality	Percentage.
Pneumococcus Type I	29	18.0	4	13.8
Pneumococcus Type II	15	9.3	5	33.3
Pneumococcus Type III	13	8.1	3	23.1
Pneumococcus Type IV	104	64.6	17	16.3
	<hr/> 161	<hr/>	<hr/> 29	<hr/>

TABLE III
INCIDENCE OF STREPTOCOCCUS TYPES

	Incidence.	Percentage.	Mortality	Percentage.
Hemolytic streptococcus	118	64.8	41	34.7
Non hemolytic streptococcus	64	35.2	6	9.3
	<hr/> 182	<hr/>	<hr/> 47	<hr/>

TABLE IV
PNEUMONIA AND EMPYEMA

	Cases.	Deaths.	Mortality per cent.
<i>Pneumococcus in sputum and pleural fluid</i>			
Pneumococcus Type I	4	0	
Pneumococcus Type II	4	2	50
Pneumococcus Type III	0	0	
Pneumococcus Type IV	6	3	50
	<hr/> 14	<hr/> 5	<hr/> 35.7

<i>Streptococcus in sputum and pleural fluid.</i>	Cases.	Deaths.	Mortality per cent.
Hemolytic streptococcus	37	21	56.8
Non-hemolytic streptococcus	4	3	
	<hr/> 41	<hr/> 24	58.5
<i>Sterile empyemas:</i>			
Pneumococcus Type I in sputum.	1	1	
Pneumococcus Type II in sputum	2	2	
Pneumococcus Type III in sputum	1	1	
Pneumococcus Type IV in sputum	5	2	
Hemolytic streptococcus in sputum.	3	2	
Non-hemolytic streptococcus in sputum	3	1	
(Sputum not typed)	1	1	
	<hr/> 16	<hr/> 10	66.6
<i>Sputums not typed.</i>			
Hemolytic streptococcus in pleural fluid	8	7	
Pneumococcus Type IV in pleural fluid	1	1	
Staphylococcus aureus in pleural fluid.	11	0	
	<hr/> 20	<hr/> 8	80
<i>Mixed infections:</i>			
Pneumococcus Type II in sputum Hemolytic streptococcus in pleural fluid	2	1	
Pneumococcus Type III in sputum Hemolytic streptococcus in pleural fluid	1	0	
Pneumococcus Type IV in sputum Hemolytic streptococcus in pleural fluid	5	2	
Pneumococcus Type II in sputum, Non-hemolytic streptococcus in pleural fluid.	1	1	
Pneumococcus Type IV in sputum Non-hemolytic streptococcus in pleural fluid	2	2	
Pneumococcus Type IV in sputum Staphylococcus aureus in pleural fluid	1	1	
Pneumococcus Type II in sputum Pneumococcus Type II and IV in pleural fluid	1	0	
Pneumococcus Type IV and non-hemolytic streptococcus in sputum Staphylococcus albus in pleural fluid	1	1	
Pneumococcus Type IV and non-hemolytic streptococcus in sputum Sterile pleural fluid	1	0	
Pneumococcus Type IV and hemolytic streptococcus in sputum Sterile pleural fluid	1	0	
Pneumococcus Type IV and hemolytic streptococcus in sputum Hemolytic streptococcus in pleural fluid	1	0	
	<hr/> 17	<hr/> 8	

TABLE IV—*Continued*

<i>Mixed infections</i>	Cases	Deaths.	Mortality per cent.
Hemolytic streptococcus in sputum, Pneumococcus Type IV in pleural fluid	1	0	
Non-hemolytic streptococcus in sputum, Hemolytic streptococcus in pleural fluid	1	0	
	<hr/> 2	<hr/>	<hr/> 42.1
Total number of empyemas		99	
Total number of deaths		55	
Mortality, per cent.		55.5	

ANTHRAX

BY MAJOR CHARLES L. MIX, M. C., U. S. A.

Medical Director of Base Hospital, Camp Mills, Long Island

ON the 11th day of June, 1918, we received our first case of anthrax at the Base Hospital at Camp Mills. The patient, W O B (No 2184), a native of Arizona, had recently arrived from the Southwest. He had had no tropical service or diseases and his family history was immaterial. The thing that disturbed him was a left cervical cellulitis. The entrance diagnosis was "cellulitis, left cervical region, anterior. Severe Cause unknown." We learned that on the 9th day of June he noticed a pimple on the left side of his neck, well forward. This gradually enlarged and led to a marked cellulitis with subjective soreness of the left side of the neck. On entrance he was sent to a surgical ward where an operation was done on the same day, the neck being merely incised and drained. Culture made at the time showed numerous staphylococci present. Owing to the fact that the condition of the patient was far more serious than would be warranted by staphylococcus infection, subsequent bacteriologic examination was made on the following day, and on June 14th, forty-eight hours after entrance, a culture from the wound showed anthrax bacilli. Immediately 100 c.c. of antianthrax serum were given intravenously and an additional 100 c.c. later in the day. On June 15th the pulse was rapid and weak, the respiration shallow, and his condition was bad, 350 c.c. of antianthrax serum were given intravenously during that day. In addition, the wound was covered daily with wet boric acid dressings saturated every two hours, and an ice-bag applied to his head. The temperature was always high, ranging from 103.2° to 104.6° F. He slept very little.

At the time of the operation curetings from the neck were sent to the laboratory for examination, and no micro-organisms were then said to be demonstrable. It was not until the afternoon of June 14th that a culture from the deep structures of the neck showed staphylococci and a spore-bearing bacillus resembling anthrax morphologically.

Antianthrax serum was given as follows

June 14th, 3 15 P M, 100 c c, 8 00 P M, 100 c c

June 15th, 11 30 A M, 50 c c, 4 15 P M, 100 c c, 7 30 P M, 200 c c

At 9 30 P M he had a chill, resulting from the last serum injection, which lasted fifty minutes. He was given no more serum after the last injection at 7 30 P M on June 15th, his condition being so bad that a fatal ending seemed inevitable. He died at 1 10 P M on June 16th.

We frankly confess that this first case of anthrax was neither promptly recognized nor effectively treated. It is the only one of the entire 6 cases which we have had which ended fatally. The faults in the treatment of this case were late diagnosis, made two days after entering the hospital and five days after being taken ill, and improper and imperfect treatment. In our opinion at the present time it is unnecessary to make deep drainage incisions into the associated cervical cellulitis, the main essential being merely to excise the malignant pustule itself. Furthermore, prompt recognition of the true nature of the condition is a *sine qua non* for recovery. Unless the condition is promptly recognized, inevitably the disease spreads through the body, bacillemia results, and the patient dies.

The remaining cases of anthrax may be briefly summarized as follows

CASE II—C U This patient entered the hospital June 12th, the day following the entrance of Case I on June 11th, he left August 23d. The admission diagnosis was "undetermined." The patient stated that on June 8th he noticed a small pimple on the right side of his cheek, that he then went to the regimental surgeon, who opened it, but that after this slight operation his face became swollen and tender, the swelling extending down

the neck and into the submaxillary region. On entrance into the medical service of the hospital the patient presented a distinct malignant pustule on the right cheek with marked swelling extending from the ear down the neck. He felt sick and had severe headache. The cervical glands could not be picked out individually, there being merely a very large mass. He was at once taken to the laboratory from the receiving ward, the pustule was opened, and a slight amount of pus and serous fluid exuded. A smear showed the presence of staphylococcus. In view of the patient's very serious condition I would not accept this report and demanded another search. On the next day, June 13th, the anthrax bacilli were found. Though this patient entered twenty-four hours later than Case I, the anthrax bacilli were found on June 13th, twenty four hours earlier than in the case of W O B. Antianthrax serum was given to him at once intravenously in a dose of 50 c.c. At 11 00 P M. an additional 50 c.c. were given. From this time on administration of the serum was as follows:

June 14th, 4 30 A. M., 50 c.c., 9 00 A. M., 50 c.c., 2 30 P. M., 100 c.c.

June 15th, 11 00 A. M., 50 c.c., 4 00 P. M., 100 c.c.

June 16th, 10.30 A. M., 100 c.c.

June 17th, 10 00 A. M., 50 c.c.

June 19th, 10 00 A. M., 40 c.c.

This patient was at first treated entirely in the medical service without surgical intervention, the only thing done with a knife was the opening of the pustule and the making of a smear from the pus it contained. The lesion on the face was, of course, dressed daily with wet boric acid dressings and the usual aseptic precautions were taken. His temperature at entrance was 102.4°F , on June 13th, 101° to 103.2°F , June 14th, from 101° to 102°F , on the 15th it ranged from 99°F at noon to 101°F at 8 P M. The last high temperature recorded was on this date at midnight, when it was 100.4°F . On the morning of the 16th temperature was normal and remained so from that time on.

The course of this patient's recovery is rather interesting

He was extremely uncomfortable on the morning of June 12th, when he entered the hospital, at which time the pustule was opened. On the following morning he complained of headache and pain in the neck and back. On June 14th he had the same complaints, but the cellulitis was greater. On June 15th he seemed to be quite ill and complained very much of headache and aching bones, though the fever showed a tendency to a lower range. June 16th the patient appeared much improved, his temperature was down, the pulse good, and the swelling behind the ear and about the neck was subsiding. June 17th and 18th his condition steadily grew better, so that by the 19th the amount of swelling of the neck was considerably lessened. The wound at the site of the pustule showed signs of clearing up, and on the 20th was evidently fading away. By the 21st it was possible for him to sit up in a chair.

The only difficulty which marred his convalescence was an urticarial rash extending over the whole body. Though serum was given to him as early as June 13th, the urticaria did not appear until June 23d. This gradually subsided, being helped possibly by adrenalin, which was given for that purpose in doses of $\frac{3}{100}$ grain hypodermically. By June 30th the pustule was so far healed that the scab upon it came off and left practically no scar, although on July 2d the right submaxillary gland was still tender and somewhat swollen. From this time on, however, this gland began to show signs of breaking down, the swelling increased, the mass being somewhat hard and indurated, so that on July 6th it was judged advisable to give the patient a little ether and open up the infected area. This was the only surgical operation done upon this patient. After operation the condition rapidly cleared up, so that by July 13th drainage had practically ceased, and by July 20th he had entirely recovered. The patient, however, was somewhat of a neurasthenic and complained of inability to do full work, and we kept him for a longer convalescence than was perhaps necessary, namely, until August 23d, at which time he was discharged.

The management of this patient's case was better than the management of the previous one, but it was not the best manage-

ment at that. He was admitted to the medical, not to the surgical, ward, where opportunity for more extensive study was possible. The result was a diagnosis made within twenty-four hours' time after he entered the hospital, prompt administration of antianthrax serum, and quick control of the disease. It was quite interesting to observe how he responded to the serum. It will be noticed that clinically he behaved very much as a case of diphtheria behaves after the antitoxin has been administered. The temperature fell quite rapidly and even the toxemia quickly disappeared, so that the patient very rapidly improved.

The similarity between the effects produced by diphtheria antitoxin and antianthrax serum was shown in another way. Just as the membrane, edema, and swelling fade as if by magic from the throat of the diphtheritic patient, so also under the beneficent influence of the anthrax serum the local malignant pustule healed spontaneously, a scab appeared upon it, and later fell off, leaving no appreciable scar and no deformity such as follows the usual excision operation. I am almost of the opinion, though the number of cases is too small to base an opinion upon, that anthrax cases may ultimately be treated in the same way that diphtheria cases are. Whereas in former years much attention was paid to the local treatment of the throat in diphtheria, in later years such treatment has been largely disregarded because of the far reaching effects obtained by the use of diphtheria antitoxin. It may also be true in the future that cases of anthrax will be treated largely by the antianthrax serum, the immediate malignant pustule and other local conditions being left to take care of themselves. Nevertheless, in view of the lesson from the four remaining cases, possibly the best method of dealing with anthrax is to excise the pustule, making no incision for drainage in the area showing cellulitis, and to treat the case with antianthrax serum. This combination treatment, surgically by excision of the sore and medically by the administration of antianthrax serum, will probably be found to be the best method of procedure.

CASE III —C D This patient entered the hospital June 18

1918, from Florida, with a diagnosis of "anthrax" (?) He stated that on June 16th he noticed a small pimple over his right cheek. He picked this and expelled a small amount of fluid from it, but no pus. On the following day the sore became large, swelling appeared, and extended down the right side of the face and neck. He complained of severe headache and fever and stiffness in the back of the neck. The pustule was an exceedingly malignant appearing sore on the right cheek, about $\frac{1}{2}$ inch in diameter. About the sore there was a good deal of marked induration extending from the cheek down the right side of the neck. The patient appeared very ill and feverish, and showed marked constitutional symptoms. He was at once taken to the laboratory and the diagnosis made then and there, but in this instance we followed a new line of procedure. The pustule was excised and the anterior and posterior triangles in the right side of the neck were opened wide. This was done as promptly as possible. For example, the patient entered at 11 00 A. M., and the administration of the anesthetic was begun at 2 00 P. M.

Some interesting observations were made in regard to the bacteriology in this case. The pustule itself showed anthrax bacilli, and they were found in the tissue for a distance of about 1 inch. No anthrax bacilli were found in the incisions made in the anterior and posterior triangles of the right side of the neck.

A new line of procedure was also adopted in giving the anti-anthrax serum. He was given 150 c c intravenously and an additional 50 c c were injected into the wound on the face about the place from which the sore had been excised. Next day the patient was very ill and 200 c c of antianthrax serum were given intravenously. The wound looked clean and wide open. Fever was high, ranging from 104° F at noon, which was the temperature he had the previous day at entrance, to 101° F that night at 11 00 P. M. On June 20th the patient's pulse fell to its lowest, namely, 80, though the quality was good, from a maximum of 110 the preceding day. He appeared very ill and was extremely restless, 200 c c of antianthrax serum were given intravenously and quite a reaction followed, the temperature rising to 105° F at 4 00 P. M., his pulse, however, was only

88, showing that the temperature was probably due to a marked serum reaction. At 11 00 P M temperature was 102.8° F and the pulse 80. Examination of the region of the excised pustule showed the wound to be clean. The swelling behind the right ear and along the neck had also subsided.

June 21st 200 c.c. of antianthrax serum were administered intravenously. Temperature was distinctly lower on this date, the maximum being 101.6° F, the general condition showed some improvement, and the pulse was of good quality. On June 22d he reached normal temperature for the first time at 4.00 P M, and from then on had no more fever. He complained merely of soreness in the neck on that day. The wound appeared in excellent condition, and in the evening he confessed to feeling quite well. On June 23d he was much improved, his general condition was good, and the swelling had disappeared. From this time on the patient gradually grew better until the time of discharge, when he had no pain or swelling and the scar on the neck and face had entirely healed.

This patient taught us that incision of the area of cellulitis is quite unnecessary. The cellulitis can safely be left to the antianthrax serum. Excision of the malignant pustule alone seems sensible, since it prevents the spread of the disease. Nothing was gained, however, by the incision in the neck and drainage, the pus from this was always sterile as to anthrax bacillus, and the subsidence which took place was apparently not at all due to the incision, but to the antianthrax serum which was given.

CASE IV—J E P, native of Minnesota. This patient entered the hospital July 5, 1918 with a diagnosis "undetermined," and left the hospital August 23d. The patient came in at 10 00 P M, and was immediately rushed to the laboratory, where the pustule was examined bacteriologically. He said that on the morning of the preceding day he scratched himself while shaving on the right side of the face just below the lower jaw. On the following morning he noticed a pimple over the area which had been scratched. He continued working until night, when he began to complain of headache, fever, pain on

the right side of the neck, and swelling of the neck. He had not been engaged in taking care of or in handling cattle nor in any occupation bringing him in contact with furs.

On the right side of the face, below the angle of the jaw, the malignant pustule was located, it was a sore $\frac{1}{2}$ inch wide with a black scab over it, emphasizing the appropriateness of the French term *charbon*. There was swelling and induration above the sore and cellulitis of the neck extending clear across to the opposite side. He had severe headache, fever, and aches and pains all over his body. The greatest amount of pain, however, was located about his jaw.

Immediately upon the finding of anthrax bacilli in the laboratory, 150 c c of antianthrax serum were given intravenously. He was also prepared for operation, and at 11 30 P M the pustule, under local anesthesia, was excised. On this occasion, owing to our experience with the preceding case, it seemed wise to do no more than excise the pustule. On the night of his entrance the temperature was not taken, but on the following morning, July 6th, at 6 00 A M the temperature was 102.6° F, at 6 00 P M it had reached 103° F, which was the maximum. The pulse ranged from 90 to 100 on that day. July 7th the temperature ranged from 99.8° to 101° F, and pulse from 60 to 74. He complained of some pain over the left side of his face, but seemed, on the whole, to be reasonably comfortable. By the night of July 7th, forty-eight hours after entrance to the hospital, the swelling on the left side of his face, which had extended to that point from the right side, was already beginning to disappear. On July 7th 150 c c of antianthrax serum and on July 8th 100 c c of antianthrax serum were given. This was the last day he seemed to require it. On July 9th his condition was much improved, the temperature had been normal all day, and he was very comfortable. On July 19th he was so far improved that we let him out of bed, and from that time until his discharge on August 23d he had no further trouble. Like the other case, he was kept for a long time to be certain that he was ready for overseas duty before his discharge.

It is rather interesting to note in this patient's case the fact

that after the cessation of antianthrax serum therapy his pulse ranged from 50 to a maximum of 60. Indeed, his average pulse range on July 9th and 10th was 56. Subsequent to that time there was an increase in his pulse-rate. This would seem to suggest that the bradycardia which is observed both after diphtheria antitoxin and antianthrax serum is quite as much due to the serum as to the disease for which it is given.

CASE V—S. H. G. This patient entered on July 7, 1918, at 11 50 A. M., with a diagnosis of "acute infection of the face." Owing to our experience in the four preceding cases, there was no great delay, and within ten minutes the diagnosis had been made, the laboratory report showing a large number of Gram-positive bacilli resembling anthrax bacilli. He was immediately given 150 c.c. of antianthrax serum intravenously and taken to the operating room for operation, which took only ten minutes, and consisted merely of excision of the pustule under chloroform. On July 8th 150 c.c. of antianthrax serum were given intravenously and the same dose again on July 9th at 2 45 P. M. This last injection was followed by a chill lasting fifteen minutes, the temperature rising to 103.8° F. The fever rapidly subsided, however, being 101.8° F. by the next morning, July 10th, and gradually falling throughout that day. On July 11th the temperature was 98.4° F. at 7 00 A. M., and from then on he had no more fever.

The appearance of this man's face when he entered was about the same as it is in most of the cases. He had an irregular, hard, indurated sore on the left side of the face at the corner of the mouth, with a black scab on it about $\frac{1}{2}$ inch in diameter, with an indurated area about it of $\frac{3}{4}$ inch. There was marked swelling and induration about the left side of the face and neck and the swollen area was tender and painful. The patient was unable fully to open his mouth. There was much tenderness over the jaw. In addition, there was slight enlargement of the glands in the cervical region, but for the most part a diffuse cellulitis extended over the whole of the side of the neck, so that he looked like an exceedingly exaggerated case of unilateral mumps.

Convalescence in this patient was about as one would expect it to be in a case successfully treated by antitoxin or serum. On July 11th the swelling was much as it had been, but after that date the swelling very rapidly subsided. On July 18th the wound was healing and the patient was feeling very well and his condition was excellent. On July 12th he showed marked urticaria which extended over his whole body, but aside from this there were no other complications.

CASE VI—P. L. This patient entered the hospital August 5th, with the diagnosis "anthrax suspect," and left cured on September 1, 1918. [It does not seem wise to prolong convalescence of these patients unduly lest they become "hospitalized"]

This patient, an Italian, quite unable to speak English, managed to let us know that while shaving on August 3d, two days before his entrance to the hospital, he cut himself on the right side of the face over the zygoma, and by night swelling had appeared, although there was no pain or discharge. When he came to the hospital the right side of his face was much swollen. The place where he had cut himself looked like a boil with a black center and was surrounded by a great deal of induration. The malignant pustule was about the size of a quarter of a dollar. The diagnosis was promptly made, the laboratory report showing from the lesion itself a Gram-positive bacillus closely resembling the anthrax bacillus. The sore was immediately excised, this time under ether, the operation requiring only fifteen minutes. No incision was made into the cellulitis. The following day the laboratory reported that the excised pustule showed a circular, granular compact center with radiating filaments and that the smear showed thread-like chains of anthrax bacilli with their characteristic spores.

The patient was given 150 c.c. of antianthrax serum intravenously on entrance, August 5th, again on August 6th, and again on August 7th. The last dose, 100 c.c., was given on August 8th. The patient began showing improvement as early as the 7th of August. Temperature was 102° F., with a pulse of 92 on entrance, but by August 7th the temperature was normal all day long and he showed a bradycardia that the other

cases showed, his pulse ranging from 53 to 61. This bradycardia lasted for a few days, but subsequently the pulse began to rise to a more normal rate. The sore healed rather rapidly and recovery was uneventful.

This patient, on the whole, was probably the least ill of any of our cases. His highest temperature during the course of his illness was only 102° F.

The diagnosis of anthrax is, on the whole, fairly easily made. The sore is a malignant pustule and is properly so named. It appears about as malignant as the head of a rattlesnake, and on seeing it you realize that you are dealing with something inimical to life. Thus, when the laboratory man sends back the statement that culture shows staphylococci, you immediately know he is not right, and you demand another culture in order to learn the true state of affairs. But *cultures are not really the best test*. The thing to do is to take the patient to the laboratory and put a needle into the pustule itself and take from it a little pus and some serum and smear it upon a slide and stain it. The Gram-positive bacillus will be immediately found and can be identified by its size, characteristic appearance, and its spores as the anthrax bacillus. The malignant pustule is usually from $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter. There is usually a history of a very short duration of illness, with great severity of intoxication. It is so malignant that within twelve to fifteen hours after the appearance of the pustule the cellulitis has started. The pustule is almost invariably black in the center, giving rise to the French descriptive term characterizing anthrax. This black center is surrounded by very fine punctate pustules making up the aggregate of the general pustule.

Anthrax in some respects resembles syphilis in that it has a primary sore from which the disease is spread into and through the body. The malignant pustule of anthrax is the chancre of syphilis. There is only one sore. The rest of the body is entirely free from skin lesions. About the sore there is usually a very marked induration which may extend for 1 or 2 inches. In the outlying district nature makes every possible effort to cofferdam the infection by blocking the lymphatics. This leads

to an extremely marked cellulitis extending for many inches from the sore, ranging, in one of our patients, to the infraclavicular region on the right side

The constitutional symptoms in these cases are extremely marked. The patients in all six instances complained of severe headache and constitutional symptoms resembling those of influenza or any other acute infection, these consisting of severe headache and pain in the extremities and a general feeling of prostration or malaise.

Treatment in these cases should be twofold. The first step is the immediate diagnosis, and this to be made by *direct smear* and *not by culture*. The next step is the immediate giving of from 100 to 150 or 200 c c of antianthrax serum, depending on the severity of the case. This should in all instances be given intravenously. It is probably not necessary to inject any of the serum about the site of the pustule, though we did that in one of our cases. The third step is the excision of the pustule itself. This can be done with ordinary local anesthesia or with a little ether. The wound should be left open. In three or four days, when the cellulitis has begun to subside under the beneficent influence of antianthrax serum, the wound can be sutured together and there will usually be prompt healing.

American literature has not very much in it concerning the treatment of anthrax. Fortunately for us, however, in this country very few cases appear, and those, for the most part, in persons handling furs or hides. Most of the cases have proved fatal largely because there was no proper treatment for them. Our own cases, in all six instances, got their infection from shaving, and there is reason to believe the rabbit hair used in the manufacture of shaving brushes was responsible. Though we made every effort at this hospital to find anthrax bacilli in the shaving brushes of the six men, we did not succeed. Perhaps the only way in which success can be attained in this direction would be to emulsify some of the hairs of the brush and inject them into the peritoneum of guinea-pigs. We had no such facilities at our disposal and were unable to cultivate the germs from the shaving brushes themselves.

Alexus McGlannan, in Musser and Kelly's Practical Treatment, vol iv, p 325, advises the complete excision of the focus of infection by means of a cautery, provided the operation does not produce great mutilation. If the operation should be likely to produce great mutilation, he advises the injection of pure carbolic acid into the tissue circumferential to the pustule. He states that when there is evidence of great constitutional disturbance, antianthrax serum should be given and, if possible, a blood-culture made.

In our opinion the injection of the pustular area with pure carbolic acid is quite unnecessary. Personally, I would not be very anxious to have pure carbolic acid injected into any part of my anatomy if there were any other means of combating the disease. Furthermore, I should not refuse, even though the operation might be mutilating, to have the pustule excised, no matter what its location.

The treatment of anthrax by the antianthrax serum is by no means new. It was advocated as early as 1904, and Sclavo, who has used his own antianthrax serum ever since 1898, reports a mortality of only 6.09 per cent. in 164 cases of anthrax in man. When antianthrax serum is given it should be given just as diphtheric antitoxin is given, namely, as long as it is needed, and in as great a quantity as is needed. Give at least 200 c.c. per day until the patient has gotten over the intoxication.

The prognosis in cases of anthrax depends on prompt recognition, prompt excision of the pustule, and prompt treatment with antianthrax serum. A statement by Kolmer to the effect that in his experience patients with sterile blood-culture have invariably recovered, while those with bacilemia have usually died, is really meaningless. If you wait long enough, a patient without the bacteria in his blood will get them into it, and if you wait still longer after they have gotten in, the patient will die. There is no such thing as two classes of anthrax patients, those with bacteria in their blood and those without. There is, however, such a thing as two stages of anthrax, the stage in which the germs have not yet reached the blood and the stage in which they have, and I am of the opinion that if one waited

long enough in a given case the second stage will invariably follow the first

The prognosis in all cases of untreated anthrax is bad. It is true that a few of them have been reported in medical literature as recovering more or less spontaneously, but unless there is prompt excision of the sore and antianthrax serum is promptly administered, a fatal issue can be looked for. On the other hand, it is a fair assumption, since our last 5 cases uniformly recovered, that prompt diagnosis, prompt administration of plenty of antianthrax serum (one of our patients receiving 800 c.c., nearly a quart), and prompt excision of the sore will lead uniformly to recovery. At any rate, I feel perfectly willing to take my chances of winning the fight in the next case of malignant pustule which I encounter.

CARDIOVASCULAR DISEASES AT CAMP BEAUREGARD, LA., FOR YEAR ENDING SEPTEMBER 15, 1918

BY MAJOR DONALD J. FRIZZELL, M. C., U. S. A.

Chief of Medical Service

In reviewing the cardiovascular diseases at this camp it has not been the object to show by a review of vast numbers the prevalence of heart conditions, or cite rare cases, or give any startling statistics as to cure or repair of these damaged hearts. Being interested in heart conditions the poverty of material was evident from the beginning of my stay here, and the reason for that condition in the South has been of great interest. To begin with, we may dismiss careful segregation before admission to the army as a reason for the small number of organic heart conditions. If we did this we must hold that most of the examiners were heart specialists and, therefore, incapable of detecting gross pathologic conditions in other portions of the body.

Since the hospital has opened we have had 264 cases that were diagnosed "heart disease" either primarily or secondarily. The table given on page 602 shows the total number with their final disposition.

Of these 264 cases, 94 may well be classed as organic, the other 172 were functional, 139 of them being true cases of irritable heart.

The small number may be better emphasized by the statement that these organic heart cases averaged 5 per thousand admissions to the hospital, the functional, about 8 per thousand. Of course, not all the heart cases have entered the hospital as shown by the records of the District Hospital. Of the first 1000 cases discharged on Surgeon's Certificate

CLASSIFICATION AND DISPOSITION OF CASES OF HEART DISEASE
IN BASE HOSPITAL, CAMP BEAUREGARD, LA., FOR
YEAR ENDING SEPTEMBER 15, 1918

Classification.	Duty	S.C.D	Transferred.	Died.	Total.
Mitral insufficiency	41	13	0	0	54
Mitral stenosis	9	2	0	0	11
Aortic insufficiency	3	4	1	0	8
Valvular heart lesions	8	1	0	0	9
Myocarditis	2	1	0	0	3
Heart disease, congenital	0	1	0	1	2
Endocarditis	0	0	0	1	1
Pericarditis	2	0	0	4	6
Pulmonic lesions	0	0	0	0	0
Cardiac hypertrophy	6	1	0	0	7
Arrhythmia	5	0	0	0	5
Tachycardia	9	0	0	0	9
Cardiac disease, functional	7	1	0	0	8
Neurocirculatory asthenia	88	48	3	0	139
Paroxysmal tachycardia	2	0	0	0	2
Total	182	72	4	6	264

Duty = Return to full duty, domestic service (with guard duty), or light duty (without guard duty)

S C D = Discharge on surgeon's certificate of disability

Transferred = Transferred to special hospital for further treatment.

Disability from Beauregard there were 46 heart cases, distributed as follows

Mitral insufficiency	34
Mitral stenosis	1
Aortic insufficiency	3
Arteriosclerosis	6
Cardiac enlargement	2

Of 121 cases of this first 1000 discharged on a diagnosis of psychoneurosis there is no question but a certain number were cases of neurocirculatory asthenia, no study having been made of these cases until late in April, about two months after these 1000 discharge cases were analyzed

The practical absence of arrhythmias noted is, of course, not surprising, as you would hardly expect in the army age (twenty-one to thirty-one) many cases with sufficient pathology in the heart muscle to give permanent irregularities Sinus arrhythmia

is exceedingly common and cases with premature contractions are not rare, because of their lack of significance among otherwise healthy men no record has been kept of the absolute frequency of such conditions. One case of mitral stenosis had a period of eight hours of fibrillation of the auricle. At the end of the period the heart-beat became regular and remained so during a period of two months' observation in the hospital. No cases of heart block, auricular flutter, or alternation have been reported.

The tachycardias seemed to be of three types. Those following acute infectious diseases, these with two exceptions gradually slowed down and the patient became fit for duty. A second type—associated with the syndrome neurocirculatory asthenia—will be discussed more fully later. Two cases had distinct periods of paroxysmal tachycardia with premature contractions, probably of ventricular origin, between the attacks.

Cases of high blood pressure are rare, 8 cases have been noted with pressure over 160 (systolic). This, of course, does not include officers who have been in the wards or appeared for examination.

On account of the discussion as to whether these neurocirculatory asthenia cases are not due to thyroid intoxication it seems well to record the fact that thyroid involvement is practically unknown in the region from which the bulk of these troops came—Mississippi, Arkansas, and Louisiana. In the first seven months of the existence of the hospital one doubtful case was seen. Since that time there have been 15 cases either admitted or sent for examination to the hospital. All of these cases were sent down to Camp Beauregard from Camp Taylor, and had been recruited from northern Ohio and Indiana. The southern physicians on service here at the hospital concur in this opinion that diseases of the thyroid are unknown in this section. On the other hand, 90 per cent. of the cases of neurocirculatory asthenia came from the extreme southern states.

The rarity of organic lesions of the heart is due, in my opinion, to the few cases of streptococcus infection in the southern men. They rarely give a history of tonsillitis, and acute infec-

tious arthritis is most uncommon. Great numbers of them complain of rheumatism, but from a rather close study we feel that most of these cases are due to weakened muscles and bad posture. Rheumatism as a result of gonorrhea is a very common complaint, but the lesions do not bear out their statements. On account of the danger from overstrain all cases of true organic heart disease have been or should be discharged from the army. Only about 10 per cent. of these cases needed any treatment except relief from heavy bodily exertion, 90 per cent. of them stood exercise of any kind much better than the functional heart cases.

The large group of cases, 139, which have been definitely classed as neurocirculatory asthenia have held out great interest for us all. After studying them for six months, placing them under the best conditions as to food, rest, and exercise, the most skeptical of us have come to the following conclusions:

- 1 That it is absolutely useless to take any of these cases into the army. The syndrome should be taught to all examiners, and when recognized should be a cause of immediate rejection.

Of the 139, 88 were returned to some type of duty, 10 to full duty, and the other 78 to duty in Class B or C, 48 have been discharged or recommended for discharge. This after months of patient care in the hospital and individual trials with the exercises of Lewis as given in Hempstead Hospital. The cost to the government and the time of the physicians would hardly seem to be compensated for by the result obtained, as none of us felt very sure that even the 10 would "carry on" if put under any marked strain.

- 2 Our experience with treatment of these cases has proved of no avail as far as cure is concerned, and with no appreciable improvement except in mild cases. We followed strictly the method of Lewis, using his exercises B 15, C 15, C 15 second part, and D 30, with periods of rest and good food.

- 3 The exercises gave us a basis of classification which could not have been obtained in any other way. The capacity for work can be the only criterion for these cases.

4 These cases are seen only in the army or in places where examination is compulsory, because if left to themselves they are able to adjust their lives to their ability to do work. Their histories almost universally show that they have been failures or near failures because they could not stand work. Most of them have no physical pain or distress and are shy and retiring, and so would not voluntarily see a physician. If they did, he would examine them at rest when the pulse may be around 70 or 80 and give no indication of anything unless stimulated.

5 Approximately 80 per cent. of these cases used tobacco to excess. We have no means of knowing accurately their habits as to alcohol or their tolerance to it.

6 The average blood-pressure of the cases studied was slightly high for the age incidence—systolic 132, diastolic 90.

7 The pulse-rate varied markedly. The mild cases averaged 90 at rest, 130 after exercise, dropping to 100 in two to three minutes, the moderately severe, 110 at rest, 140 to 160 after exercise, dropping to 110 to 120 in two to three minutes, the severe, 130 to 140 at rest, 160 to 190 after exercise, with no return at end of five or six minutes.

8 Sixty per cent. of these cases have a family history showing nervous or mental instability.

9 All the severe and moderately severe cases had histories of many infections, and the condition having existed for three to twenty years.

10 A patient must have a majority of the symptoms enumerated below—a rapid heart, pain over the precordia, tremor of the hands, dizziness, shortness of breath on exertion, and cyanosis of the extremities—before a diagnosis of neurocirculatory asthenia could be made. Most of them could be diagnosed at a glance after exercise, their expression of agony and desire for breath is one of the classical pictures of medicine.

11 None of the races down here have been exempt—French, Scotch, Spanish, English, and even the negro have given us examples. Most of the cases, however, have been among the "Cajens," who are numerous in this region.

12 We have classed these as heart cases and discussed them

as such, but with a good many misgivings. In bed, after a night's rest or when the nurse takes their pulse when at rest, the rate may be between 70 and 80. Mental excitement, sitting up in bed, walking, anything that puts these creatures on a strain, immediately brings up their pulse. They are not of any particular build and may be muscularly well developed. Left to themselves to go their way, they have no distress.

13 After examination of this series, reading the admirable articles of Lewis, Francis Fraser, Oppenheimer, Rothschilds, and the reports from the many camps in this country, one is constrained to decide that these cases are true neuroses on a toxic basis usually of long standing. Unfortunately we have not the time to work out each and every one of them and still win the war.

The most of the material for this paper was obtained by Lieutenant Alfred Lewis, assisted by Lieutenant Fred Smith, who were given one of the wards holding about 56 patients (in the ward and on the porches). This was called the cardiovascular ward, and all cases for heart examination or treatment were sent to this ward. All true cases of heart disease were admitted and a preliminary study begun. After a week or ten days ambulant cases were sent to the cardiovascular ward in the convalescent camp, which was under the supervision of these same officers. Exercises after the plan of the Hempstead Hospital, as outlined by Lewis, were carried out night and morning. These were at first given by the medical officers, but they were soon able to instruct sergeants in the exercises, and merely supervise and watch results. The withdrawal of both these men from the department within a few weeks of each other and constant shifting of personnel since has made further work along this line impossible.

The work as outlined gave valuable information, and is the only possible means of gaining accurate data for prognosis in heart conditions in the army.

DRUG ADDICTION

BY MAJOR J M W SCOTT, M C, U S A.

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September 18, 1918

EXPERIENCE at Camp Lee shows that freeing a man from morphin addiction is an easy proceeding, and the excuse for this paper is that so many look upon drug addiction as some occult, mysterious condition, showing absolute degenerate or degenerated moral fiber and moral turpitude. It is further believed rather widely that the addiction produces in the tissues real, permanent organic changes (chemical or microscopic, or both), and that these conditions can never be cured, or require fantastically long periods for recovery or even partial correction and that excessive and almost unendurable suffering must accompany the treatment. In short, the idea is that practically all cases are hopeless and not worth effort. This is an entirely unreasonable attitude, and not borne out by the medical facts in the premises

The work was done on the theoretic lines set forth by Dr George E Pettey in his book "Narcotic Drug Diseases and Allied Ailments," and the practice developed was the result of the experience gained, the conclusion that hyoscin and allied drugs are not indicated, and that it is a mistake to use them, being the most notable change.

This paper will particularly deal with morphin addiction, as it is the really important drug Cocain, chloral the coal-tar products, and the rest are always possible to manage without very special care, as their actions on the system are of a different type. One deals with their direct poisonous effects, not with the secondary consequences Addicts who take various drugs can rather easily suspend the use of the rest, but morphin is too much for them

Morphin dulls sensation and sensibility and interferes with the normal reactions of the body, interferes with its activities, blocks excretion, inhibits or even suspends the peristalsis of the bowels, so the feces are retained unduly long, and a great increase in the quantity of autotoxins in the body occurs. While at rest they are relatively harmless, and the attempt is made to keep them so by repeated doses of the drug. There have been people where the amount used was held at a moderate point, who have gone on for years taking morphin, and living rather full and active lives, although always limited and handicapped by their addiction. Such examples are rare, the rule being that body routine and metabolism are so disturbed that the quantity used is increased steadily, the general health impaired, anemia developed, efficiency and dependability destroyed.

The practice of drug using is established as a form of running away on the part of the victim or his physician, or develops as a consequence of association with habitués.

The individual uses it to get relief when uncomfortable in any way. Physicians prescribe it sometimes as the easiest way of handling a case, either because of laziness or carelessness, or because of ignorance. It often saves the effort necessary to properly diagnose and treat a patient.

Many have started because associates persuaded them to try the effects. Certain pool-rooms and other rendezvous have really been schools and centers for the development of habitués. Sometimes drugs are used by acrobats, dancers, and other stage people with the idea that it will enable them to put more force, vivacity, and effectiveness into their acts, in spite of the long irregular hours of effort, hard railroad journeys, and frequent loss of sleep. Sometimes the condition has been developed in individuals who heard of the stimulating effects of the various drugs and found the action from alcohol too slow. The habit may develop in normal persons, and such constitute probably 75 per cent of the cases, but, of course, it is readily recognized that one of poor psychic fiber is much more susceptible to the discomforts and temptations that lead to the formation of the addiction, and much more apt to relapse.

after being freed from the disability If one much prefers being an addict to being free, the only thing for him is to be under the control of some authority outside himself Any one will develop the habituation in a short time (say a month) if the drug is used in appreciable dose and with frequency

Hyoscin, scopolamin, atropin, and other drugs of this group are suggested and used in the various sanatoria and cures, and are advocated by Pettey, but the writer's experience with them was not happy They are the physiologic antidotes for morphin poisoning, but that is not the condition that obtains in addicts Of all the cases seen in Camp Lee there was but one case of poisoning, and that man, as a final fling, had taken two or three times his usual dose, if not more (It was not possible to get an accurate, reliable statement from him) Pettey uses these drugs after the morphin has been withdrawn, others advocate them as almost the whole reliance The writer's experience is that when the condition comes that is usually met by giving hyoscin, it is absolute evidence that the man needs morphin A dose or two will restore the even tenor of events, and no drug and no combination of drugs that does not contain morphin will do so Hyoscin will knock the man out, confuse him, dry his throat and mouth, make him feel miserable in addition to what he is already suffering from the morphin deprivation, and, often, will make him delirious and hallucinated, all of which is unnecessary and cruel and subjects the system to great and unwarranted strain If hyoscin is given, insult is being added to the injury of refusing the drug before the body is prepared for its orderly and proper withdrawal

As above stated, morphin blocks excretion, and one is dealing with auto- and intestinal toxins and their elimination in large part is proper before morphin is suspended as otherwise, as soon as the primary effects of the drug wear off nature tries to remove them too rapidly These toxins are probably no new combinations to which the body is unaccustomed, but simply the usual waste products which have accumulated in unusual quantity As soon as they are eliminated the body takes up its functions again, and there is nothing occult or weird, and no

great organic change Deprivation symptoms include fever, usually moderate, but it may run very high It probably occurs in all cases where the drug is suddenly withdrawn, except in those cases in which severe diarrhea gives the hint from nature as to the best and most rational treatment It is noticed that when the bowel action is most free the patients pass through the withdrawing period most easily

Other symptoms are diarrhea, abdominal colic, nausea, vomiting, extreme pains and aches in the muscles and bones (legs most complained of), malaise, prostration, headache, insomnia, sweating, restlessness, weakness, rapid and weak heart action, cyanosis and respiratory embarrassment, and intense feeling of suffering and inability to endure, as if from grip or other acute infection The condition may readily become alarming, and death can easily occur

Each case must be treated individually and as carefully as a case of pneumonia, no standing orders or routine practice being effective One great objection to some of the cures is that the whole thing is routine and the effects unbalanced and often cruel, entailing much unnecessary suffering

When the patient is first seen some little history is obtained as to how much he is taking, in what manner, what dose, and at what interval, and when the last dose was taken How long the addiction has lasted is not important, as the reactions are nearly the same in any case The general condition is estimated, especially as to elimination, and particularly as to the alimentary canal, most attention being given to the tongue and habits as to defecation, and the time of the last movement is important If he is fairly comfortable, the tongue clean, and the bowels free, there may be no need of any morphin in this case All are given tincture of *nux vomica* (10 minims or 15 drops in water every hour), beginning at once This stimulates peristalsis and the system generally, replacing the stimulating effects of the morphin, and counteracting the auto-intoxication depression The interval is lengthened gradually as conditions warrant, the hourly dose being used two or three days If the *nux* is continued too long there appears a peculiar

irritated nervous state and gastric derangement not otherwise noted. Care should be taken not to overmedicate, but in the early stages of the treatment the dose of nux indicated is not too much, and it is hardly possible to get overcatharsis.

If the bowels have not been freely moved, an enema is given at once and an emptying of the colon secured. If no morphin has been taken for three or more hours and none is at once demanded, a cathartic is given at once. The dose must be ample. No ordinary standards of dosage, nor frequency of evacuation, nor fulness of movement will serve. There is the effect of the morphin in inhibiting peristalsis to be considered (that is why an interval after the receiving of morphin before the giving of the cathartic is necessary), and griping need not be feared as much as in the ordinary patient, the same reaction in this respect not being shown. The cathartic must be effective. Calomel seems to have a helpful antiseptic effect, as is so often noted in toxic cases. To get the best results in the majority of instances compound cathartic pills were found very efficient and satisfactory. Castor oil for one dose, to get a rapid cleansing of the canal, has sometimes been used, but is generally not oversatisfactory even for this, and is sometimes very disappointing, as there may be no movement. Calomel, followed by a saline, is also unsatisfactory, as the salts do not have a sufficiently continuous effect and do not seem to act enough on the full length of the canal. Do not fear there will be prostration if the bowels move very, very freely. The thing that prostrates is the toxins and there will be prostration if the bowel action is ineffective, not if there is excessive action. This condition is absolutely needed to get the poison from the body in time to keep the system clear and avoid deprivation effects, i. e., auto-intoxication to an excessive degree. Anywhere from five to six large movements every twelve hours to almost continuous action will keep him most comfortable, and this is necessary, as the bowel contents are nine times as poisonous as the urine, and the intestines provide the only efficient and at all adequate means of cleansing the body. If successful in keeping the waste products eliminated, so there are not

too many moving at one time, the patient will suffer very little

The dose of the compound cathartic pills is two to four, usually four, for the first dose, and three or four for the subsequent doses, from four to twelve being taken every twenty-four hours. The great difficulty in teaching the method to inexperienced men is to have the cathartic given in sufficient quantity and at frequent enough intervals. There is always the idea that the man should have a good night's sleep. This is appropriate to a later stage in the cure, but it is much better that the first twenty-four hours be spent almost entirely in emptying the bowels. The patient is very much more comfortable, gets on much faster, and shows a much better condition after the drug has been withdrawn, and, naturally, recuperates much more quickly. It is not to be expected that he will sleep much for forty-eight or seventy-two hours, and sometimes it is a long time before the sleep is perfect. This is very unusual. As soon as the toxins have been nearly eliminated the body functions are promptly resumed in a remarkably satisfactory manner.

If when first seen the man is suffering with deprivation symptoms, a dose of morphin ($\frac{1}{4}$ grain, less often $\frac{1}{2}$ grain) is given by hypodermic. This method is used because the amount employed is readily controlled, the patient cannot tell how much he is receiving, and one avoids the feeling of dissatisfaction encountered if the patient feels an inadequate dose is being given. If the man becomes hysteric, as sometimes occurs, and demands morphin when none is needed, it is also possible to use sterile water.

If relief is not experienced in a short time (half-hour or an hour) the dose is repeated, or a larger or smaller one given, as seems indicated in the judgment of the medical attendant. Each dose is made the subject of a special investigation and order by the physician, absolutely no routine procedure being permitted. Each case must be followed and handled individually and attentively.

No more is likely to be needed for at least six or eight hours,

and none is given unless indicated. It is not often that more than three doses altogether are required.

On the other hand, it is to be remembered that the man has been using morphin and there is no danger of producing an addiction, as that is already present, and a little morphin will not hurt him, as he is accustomed to a great deal. Generally, also, two or three days are not going to make any real difference. It is better to take sufficient time to conduct the removal rather comfortably, and not subject patients to the discomfort (really, better, misery) and extreme depression caused by refusing the drug when it is really needed, the consequent exhaustion sometimes becoming a very important factor and causing more delay in the long run.

They are not hungry for some time (one to three days), and it is well that they should not eat at first, as the body is sufficiently busy on elimination, and the mucous membranes are generally covered with catarrhal secretions, so that digestion is difficult or impossible. Some light liquid diet is sometimes indicated.

Suddenly, however, they become hungry, and then it is well to force the feeding as much as conditions will allow. Sometimes it is really quite a problem to give enough nourishment to rapidly build up the patient without causing indigestion, but this is usually not noted. They are generally undernourished, and easily digested and simple foods are demanded. This does not mean prolonged use of liquids. The best results were obtained by the use of solid, but simple food.

As soon as improvement comes and the man is free from the drug he will want to be out of bed and getting about. This must be strictly controlled. They must be treated as if there were an acute disease like pneumonia (and in a sense there is) and not allowed too much liberty at first.

When the strength is returning exercise and work are of the first importance, and should receive very special attention. Hot and cold baths and, if pains in the body persist, prolonged hot baths help and during the first part of the cure they are sometimes indicated to control restlessness and the aches and pains.

It is not fair to take a man off his drug and then leave him not prepared to really meet his situation in life. All possible ingenuity and means must be employed to get him into condition. This paper refers especially to correcting the addiction, and it is not desired to prolong it with after-treatment, nor cloud the main points with outside matters. As in all things, the man must be treated rather than the disease, and each physician has his tried methods, which will indicate the required action after the addiction is corrected.

If any one thing recommends itself for use in all cases, it is suitably regulated setting-up exercises twice a day.

The ease of withdrawal is graphically illustrated by a particular case. This man had some tubercular fibrosis of the lungs, hemorrhoids, fistula in ano, and was developing an ischio-rectal abscess. When he first came into the ward a start at withdrawal was begun at once, before minute examination had established all these infirmities. He was running some fever and was partly delirious, so it was not possible to keep him in bed without someone sitting with him all the time, and his heart was acting poorly. It was decided that he was in such poor condition that it would not be wise to try to correct the addiction, so the attempt was given over. At the same time, however, he was given the best treatment available for his general condition. His bowels were kept open, other medicine was administered as indicated, and the morphin was exhibited whenever circumstances required it. He did not need a dose very often, and inside of three or four days it was noted that the intervals between doses had lengthened out until he was free from the addiction one might almost say by accident and through pure carelessness.

The patient should be in a sanitarium or suitable hospital when the drug is withdrawn. When at large he is without control and the results are disappointing. Failure and discrediting of the method and the physician may be expected if it is tried under any other conditions.

Some may ask what kind of soldiers these men made. They were sent to their organizations as soon as it seemed at all pos-

able they could stand the drill. The active regular life was entirely to their advantage, and also the simple rather coarse food, which is, of course, best for most people. A few returned to the hospital again and a few relapsed, but most of them made good soldiers, and some made excellent soldiers.

Addicts as a class are usually undisciplined and the army life is a great advantage to them and they learn that one's whims and transient feelings are not the important things in the world. Too long a tarrying in the hospital tends to break down their morale, so the time of discharge requires judgment to avoid too quick a return to active life and to avoid too slow a return. The environment to which he goes is to be taken into consideration in deciding. In the army the immediate commanding officer is important, as where discipline is best relapse is less likely to occur.

After one is freed from the addiction there are a few facts that should hold his attention and control his conduct.

If he allows himself to become worried or run down, or loses a great amount of sleep or greatly overworks, there will be great risk that he will again take up the use of the drug.

Also, if he uses alcohol in any form, the resumption is almost
Dostine

MARIE'S DISEASE INFANTILISM HYPERKERATOSIS SUBCLAVIAN ANEURYSM

BY FIRST LIEUT MACY L LERNER, M C U S A

Base Hospital Camp Joseph E Johnston Jacksonville Fla

CHRONIC HYPERTROPHIC PULMONARY OSTEO ARTHROPATHY

THIS case was in a negro, who gave a history of an acute infectious jaundice of infancy There were no detectable pulmonary or cardiac disorders The distal phalanges of the



Fig 124 —Chronic hypertrophic pulmonary osteo-arthropathy

hands and toes presented a most marked spatular enlargement, with typical cyanosis, also curving and ridging of the nails This is well illustrated in Figs 124 and 125



Fig 125 —Chronic hypertrophic pulmonary osteo-arthritis

INFANTILISM

Three typical cases of infantilism were diagnosed by the medical examiner, two of them were photographed on consent of the men. All cases showed arrest of development of sexual organs in different degrees, however, they were all characteristic and typical infantile cases. All cases had the general effeminate contour of the body, rather broad pelvis, with a suprapubic pad of fat, giving the characteristics of a mons veneris (Fig 126)

Every case had a distinct transverse pubis hair line

The hair distribution of the body, genitalia, face, and axillary pits was rather sparse

Genital Organs —Penis in 2 cases was about 1 inch in size, in the third case penis was about $1\frac{1}{2}$ inches in size. Glans penis was acorn shaped. Testicles in all cases were the size of a pea. In two of them a history was given of never having any sexual desire and never manifesting any sexual activity. The third man stated that he had occasional erections, but no emissions, also that he had occasional intercourse.

All three men expressed a wish to marry, believing that matri-



Fig 126—Case of infantilism

mony might stimulate their sexual activity Their voices were feminine and high pitched

HYPERKERATOSIS

This case was in a white enlisted man, whose general condition was otherwise good, with the exception of uniform callosities over the entire palms of hands and soles of feet The callosities were hard and caused considerable pain of hands and feet

TRAUMATIC ANEURYSM OF FIRST PORTION OF LEFT SUBCLAVIAN ARTERY

This case was in a negro aged thirty two, weight 140 pounds, occupation laborer

Personal History—Man had had pertussis, scarlet fever,

diphtheria, rheumatic fever, tonsillitis, typhoid fever, malaria, and a history of a chancre

Habits—Smokes cigars and cigarettes, also chews, all in moderation, uses alcohol to a slight extent

Symptoms—Gives a history of pain, dyspnea, palpitation, cough, giddiness, and sweating

Physical Examination—General appearance good *Heart* First sound somewhat harsh, faint systolic murmur heard at the second pulmonic, not transmitted Apex in fifth interspace, in normal position *Pulse* Radial pulse on right side somewhat stronger than on the left

Blood-pressure—On the right arm, 140 systolic, 88 diastolic, on the left, 136 systolic, 88 diastolic

Location of Aneurysm—A scar was seen over the inner third of the clavicle, which is due to a bullet wound, as stated by the man A loud bruit, metallic in character, was heard distinctly at the sternoclavicular junction, transmitted somewhat to the left below the clavicle and also to the left supraclavicular region, into the neck No expansile pulsation noticed over that region

The fluoroscopy of the heart and upper vessels, taken at the Camp Hospital, confirmed the diagnosis of an aneurysm of the first portion of the left subclavian artery

THE CLINICAL SIGNIFICANCE OF CARDIAC MURMURS¹

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A CARDIAC murmur or bruit has been defined as an adventitious sound which precedes, takes the place of, or follows a normal heart sound. Much confusion exists in the medical mind concerning the significance of cardiac murmurs. There are many who regard any type of murmur with grave suspicion, as being indicative of a serious heart defect. Other men advise that murmurs be disregarded entirely unless there be other symptoms. We believe it is true that a grave prognosis is not indicated with the majority of murmurs, but we feel that they should not be completely ignored. The prognosis rests not so much upon the type of murmur as upon the integrity of the myocardium. However, certain types of murmurs, as will be pointed out later, must be considered as having a very definite bearing upon the ultimate prognosis.

In examining large numbers of men it is surprising how many cardiac abnormalities are encountered. Murmurs of various types, accentuations, reduplications, and thrills are frequently discovered singly and often without clinical significance.

It cannot be too strongly emphasized that a murmur, *alone*, is not evidence of organic heart disease. Many murmurs are produced by conditions other than valvular impairment, and this fact must be kept constantly in mind. A murmur may or may not be an important symptom, and the physician must consider every correlated finding in order to properly interpret it. We have records of many patients who have been forced to

¹ The basis for this paper embodies the work carried out in the examination of 15,647 men. Of these, 1851 were examined by Captain Horine in the Base Hospital and 13,8% appeared before the Camp Hancock Cardiovascular Board.

spend years of inactivity because of the chance discovery of a murmur which caused the examiner to give a grave prognosis, and to prohibit any except the very lightest exercise. These patients have gone through years of mental torture, firmly believing that any exertion might lead to sudden death. Thus they have become partial physical wrecks, and, as their general musculature has suffered from partial disuse, so has their cardiac musculature.

In this brief paper we shall endeavor to consider only endocardial murmurs. The time-honored classification of these murmurs, organic and inorganic, will be used. Organic murmurs are due to permanent changes in structure of the valve leaflets or orifices. However, organic murmurs may be present without myocardial change, in which case they are relatively benign unless diastolic. Even diastolic murmurs may be present for years and give rise to no untoward symptoms, provided the myocardium be uninjured. This fact may be best illustrated by briefly reviewing one of several cases of this nature which has been observed by us.

A spare, fairly well-developed man, twenty-eight years of age, by occupation a chauffeur and mechanic, was brought to us for examination. He was 69 inches in height and weighed 120 pounds. His personal history is as follows. Repeated attacks of tonsillitis with cervical adenitis until about twelve years of age. There were no other diseases during boyhood and he was always very active. When twenty-one years of age he contracted pneumonia, was in bed for three weeks, and confined to the house for an additional three weeks. He states that he was "helpless, with severe pain in the muscles of the arms, legs, and back while sick with pneumonia." Since then he has been able to continue his work, although he complains of palpitation on severe exertion. He denies having had any venereal disease. He takes from one to two glasses of beer daily and smokes an average of fifteen cigarettes.

The physical examination revealed the maximal cardiac impulse under the fifth rib, 6.5 cm. to the left of the midsternal line. The impulse was slightly diffuse and heaving in character.

Percussion demonstrated the transverse diameter of the heart to be 11.5 cm, and this finding was later confirmed by a tele-roentgenogram. The pulse was normal in rhythm and slightly collapsing, the arteries were not infiltrated, and the radials were equal. The pulse-rates were Standing, 100, recumbent, 88, after hopping 100 times on one foot, 138, and two minutes later, recumbent, 100. Subungual capillary pulsation was present, being particularly marked after slight exercise. The blood-pressure findings were as follows

	Right brachial.	Left brachial.	Femoral.
Systolic	128	124	156 mm.
Diastolic	56	54	54 mm.
Pulse-pressure	72	70	102 mm.

Auscultation revealed the presence of a blowing systolic apical murmur transmitted laterally toward the left for a distance of 6 cm. This murmur replaced the first sound at the apex. A diastolic murmur was also heard, with the point of maximal intensity at the costal cartilage of the fourth rib to the left of the sternum. The diastolic murmur was transmitted for a short distance in all directions. The second sound at the base was practically replaced by the murmur, which was blowing in character and occupied rather more than the first half of the diastole. A double murmur could be distinguished over the femorals by careful manipulation of the stethoscope.

The Wassermann reaction was negative.

In the case just reviewed there were undoubtedly two organic lesions—aortic and mitral insufficiency dating back at least seven years. Yet the transverse diameter of the heart was normal and there was a fairly good exercise response. However, this man had been engaged in light work and thus he protected his myocardium. With the continuance of light work, involving only a moderate amount of physical exertion, he probably can go on for years. But in time the myocardium must begin to suffer from a somewhat restricted blood-supply, this, in turn, because of an inadequate coronary circulation. The myocardium is supplied with blood immediately after the clos-

ure of the aortic valves and while the pressure in the aorta is greatest. Normally this peak pressure is gradually reduced, thus favoring perfect filling of the coronary arteries. In aortic insufficiency the pressure falls rapidly and reaches a lower level than normal. The rapid decline in pressure must result in imperfect filling of the coronary arteries, and with this, as a natural sequence, undernourishment of the myocardium.

The case just reviewed illustrates a temporarily benign aortic condition. At the same time we have endeavored to show why a grave prognosis should be given. We shall now consider the diastolic or so-called presystolic murmurs heard at the apex and originating at the mitral orifice. Experience has taught that mitral stenosis is a progressive condition. With the appearance of the presystolic thrill, the presystolic roll, snappy mitral first sound, and accentuation of the second pulmonic sound we have a group of symptoms absolutely diagnostic. Even with a small degree of stenosis considerable strain is placed upon the auricle. Subjective symptoms, such as dyspnea and palpitation on slight exertion, become noticeable. As contraction of the fibrous tissue in and around the orifice becomes more marked the subjective symptoms increase, and, objectively, the murmur becomes longer and considerable irregularity develops. This irregularity is out of proportion to the subjective symptoms. Primarily, there has been a hypertrophy of the auricle, but, as the stenosis has become more marked, the auricle gradually succumbs to the strain and begins to fibrillate. Further, as the stenosis becomes more marked, the ventricle is incompletely filled and coincidentally the body is improperly supplied with blood. The cardiac musculature suffers in a like manner. Thus we see, in both aortic insufficiency and in mitral stenosis, the end-result is an interference with the coronary circulation and consequent myocardial changes.

Inorganic murmurs are frequently divided into two rather ill-defined classes (1) functional, (2) accidental. There is considerable disagreement among writers as to what constitutes these two types. Jacobi has proposed that accidental murmurs include all those sounds produced outside the heart, such as

friction rubs, either pleuropericardial or pericardial, and the impact of the heart against lung tissue or the chest wall. Under the term "functional" he classifies all endocardial murmurs not accompanied by change of structure. Babcock apparently considers these terms "accidental" and "functional" as synonymous. However, he states that "such a murmur, even though transient, signifies something more than a functional murmur." Cabot considers the terms "functional," "accidental," and "hemic" as synonymous, although he states, "the connection between anemia and functional heart murmurs is by no means as close as has often been supposed."

It is questionable as to whether any murmur should be classed as a hemic one. If altered blood states could be productive of murmurs, it would seem that at least every case of pernicious anemia should be accompanied by murmurs. Yet we have seen many cases of pernicious anemia and several with erythrocyte counts under 1,000,000 unaccompanied by murmurs. We are sure that, as the result of the anemia and general muscular weakness, the cardiac musculature also suffers, and relative insufficiency must occur in a certain percentage of cases. But the altered condition of the blood *per se* is not productive of murmurs.

Sir James Mackenzie suggests that the term "physiologic" be used for those murmurs found in healthy individuals who "lead strenuous lives and never show any sign of heart failure" or heart impairment. His assumption that a murmur may be a normal or physiologic finding is based on the fact that many healthy young people are found with murmurs. However, it has not been demonstrated among adults that the percentage of murmurs found is sufficiently high to justify the term "physiologic." Luethje, Beyer, Gerhardt, and other observers have found murmurs in school children in percentages ranging from 27 to 56 or even 72 per cent. but such high percentages have never been found in adults. Is it not highly probable that the majority of murmurs found in young people are really *functional* and due to relaxation of the orifices or other non-organic changes brought on by exercise or excitement? Our own experience not

only in young people, but also in adults, seems to suggest very strongly the conclusion that we cannot call any murmur physiologic. We feel that the sounds of a normal heart should be clear cut, subject, of course, to certain slight variations. Every endocardial murmur is abnormal and falls into one of three classes (1) Organic, (2) functional, (3) accidental.

It is unfortunate that such terms as "accidental" and "functional" have been admitted to cardiac nomenclature, and, particularly, since there is no unanimity of opinion concerning them, but we have no desire to add further confusion by attempting to suggest other terms to replace them. It would seem that the best plan would be to retain these terms and to attempt to classify definitely all non-organic endocardial murmurs accordingly. We believe the term "accidental" can be safely used to include certain endocardial murmurs to be described later.

Functional murmurs are transient and indicate some disturbance of the heart caused by varying degrees of relaxation of the myocardium or incomplete emptying of the ventricles. With functional murmurs there is no organic change in the valve leaflets or orifices, although there may be marked changes in the myocardium. It will thus be seen that we have organic murmurs without myocardial change, in which case the condition is relatively benign, or we may have functional murmurs associated with myocardial changes of great severity. The murmur, in either case, is merely a symptom which suggests the necessity for making a careful investigation.

An interesting type of functional murmur is one encountered in perfectly healthy men during active training. No murmur will be detected on examination either in the erect or in the recumbent posture before exercise. Immediately after the customary exercise test of 100 hops on one foot, there will develop a blowing apical systolic murmur which even may replace the first sound. Usually there is slight lateral transmission toward the left, and in two instances the murmur has been transmitted as far laterally as the midaxillary line. Within from thirty to sixty seconds after exercise the murmur will begin to grow faint.

and will disappear in from two to three minutes. The explanation for such a murmur would seem very simple, being merely dilatation of the musculomembranous ring of the mitral orifice, resulting in imperfect coaptation of the valvular segments.

We have also observed functional murmurs appearing during convalescence from various infectious processes, and occasionally following operative procedures. Such murmurs are systolic in time and are heard usually at the mitral area in the erect posture, becoming faint or entirely disappearing in the recumbent posture. Frequently, after slight exercise, this type of murmur will disappear entirely. After more strenuous exercise the murmur may reappear. The probable explanation here is that primarily there is a slightly relaxed mitral ring, which, after the stimulus of the slight exercise, contracts. Later, after a greater amount of exercise, there is subsequent relaxation of the ring and a reappearance of the murmur.

Also, systolic murmurs are seen frequently in the pulmonary area and occasionally in the aortic. Judging from the evanescence of such murmurs and from the fact that there is a normal or fairly good response after exercise, such murmurs necessarily must be classed as functional.

The systolic murmur observed in the pulmonary area occurs more frequently than any other murmur. It may occur in the debilitated as well as in the perfectly healthy individual. Its mode of production is still undetermined, though some change in the conus arteriosus or pulmonary artery probably causes it. It can readily be seen that relaxation of the pulmonary artery just outside of the valve would result in a relative stenosis and the production of a murmur. At times pulmonary murmurs are heard only in the recumbent posture, and a possible explanation of this occurrence is suggested when we consider that the weight of the heart may drag the pulmonary artery downward and backward and cause a murmur by partially constricting the vessel.

To be sure, inorganic systolic murmurs are most frequently seen in this area. Nevertheless, it must not be forgotten that organic murmurs also occur here. The organic murmurs are

usually loud, harsh, and rather widely transmitted. They are produced by congenital defects, such as pulmonary stenosis, patent ductus arteriosus, and defective interventricular septum. In these two latter conditions continuous murmurs may occur.

Occasionally, in a perfectly healthy person, a systolic murmur is accidentally discovered during a routine examination. The murmur may be heard in either the erect or the recumbent posture, or in both. The transverse diameter of the heart is within normal limits and the heart responds normally after exercise. The blood-pressure is normal. Sinus arrhythmia may be elicited. In other words, our only abnormal finding is a murmur. There are no characteristics which would indicate that it is organic, and, frequently, there is not even a history of any acute infectious process within the knowledge of the individual. Clearly, it cannot be functional, for then we would have some cardiac impairment and probably other signs. As we have previously stated, we do not feel that it can be classed as a physiologic condition. We are unable even to guess at its cause, and, from histories of similar cases which have come to autopsy, no valvular lesion would be found. In some cases reported an aberrant fiber across the ventricle has been found, in others absolutely nothing in the shape of an anatomic defect has been present. Until we learn more of the possible causes for such murmurs we believe that such casual murmurs will result in less confusion if classed as *accidental*. In this way a word which has already been admitted to cardiac nomenclature will be used to designate a purely accidental finding. Of course, it matters not what name is used so long as the name is understood, but it would seem that less confusion will result if this term be employed.

Of the 13,896 men examined by our boards, approximately $1\frac{1}{2}$ per cent were rejected during the routine examination at their entrance into the service. For the greater part these rejections were for mitral stenosis. Very few were rejected for mitral insufficiency, although approximately 8 per cent. presented systolic endocardial murmurs of some type. The systolic murmurs were present in the following proportions: aortic

systolic, $\frac{1}{10}$ of 1 per cent., pulmonary systolic, $4\frac{1}{2}$ per cent., apical systolic, $3\frac{2}{10}$ per cent.

These men have undergone intensive training for periods ranging from three weeks to nine months, and thus far 4 have been discharged from the service. Three of these men were discharged for mitral stenosis, and the fourth, for chronic myocarditis.

A small percentage of these men, less than $\frac{1}{2}$ of 1 per cent., has been temporarily disabled as the result of the too intensive training which produced the irritable heart of soldiers, or neuro-circulatory asthenia, as Lewis prefers to call it. The majority of these men were in clerical work prior to entrance into the service. We are unable at this time to state, even approximately, the percentage of these men which ultimately may be discharged, though we believe it will be very small. At present a few of these men are still in the hospital, some are in the Development Battalion, and the remainder have already been returned to duty.

Before we close this paper it may be well to emphasize certain points which have impressed us. A very considerable percentage of individuals having valvular impairment may lead active lives without even being conscious of such impairment. Cases showing valvular impairment plus myocardial change should be limited in their physical and mental activities and ought to be under constant medical direction—as so strongly urged by Mackenzie.

A careful investigation of the myocardial efficiency should be undertaken in every case presenting a murmur. As pointed out, diastolic murmurs arising at either the aortic or mitral orifice indicate a lesion which will sooner or later affect the myocardium. Systolic murmurs, irrespective of type, on the other hand, do not demand limitation of the individual's mode of life unless accompanied by symptoms of myocardial embarrassment. We may be too optimistic concerning cases presenting murmurs. Yet when we consider that such cases which we have observed for months, during intensive training, have not only held up but have improved under it, we feel that we are justified in our optimism.

THE PREVENTION OF THE COMMUNICABLE RESPIRATORY DISEASES

BY MAJOR CHARLES SPENCER WILLIAMSON, M C , U S A

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IN taking up this subject from the army standpoint I am doing so chiefly because I believe it may offer to men not in the service a somewhat different viewpoint from that which they entertain in civilian life. In the latter the physician treats the cases which come to him, in the service he not only does this, which is, of course, important, but he does something else which is vastly more important, *to wit*, he *concerns himself primarily with the prevention of disease*. Had I been discussing this subject at the time of the Spanish American War I should unquestionably have taken for my theme the subject of the communicable intestinal diseases, because at that time this group of maladies was chiefly concerned in both the morbidity and mortality statistics. Since that time, as every officer who has spent even a few months in the service knows, these diseases have diminished so rapidly in importance that today they occupy an entirely secondary position. Unfortunately, we have another group of diseases which have in a sense taken their place, and now are easily the most important factor in producing the sick rate in our cantonments. I refer, of course, to the communicable respiratory diseases, and I include under these all diseases which are presumably communicated from one individual to the other by means of the respiratory tract. Under this caption we may rank measles, scarlet fever, tonsillitis, meningitis, diphtheria, influenza, mumps, whooping-cough, bronchitis, and, of course, pneumonia. It would be superfluous, of course, to mention the ordinary infectious colds, since these are so well known to everyone.

With the army and things pertaining to the army uppermost in everyone's mind it will be unnecessary to refer to the statistics of our cantonments during last winter. It is only too fresh in everyone's mind how measles swept through the cantonments, leaving in its wake bronchopneumonia of great severity, and how ordinary lobar pneumonia was of almost unprecedented severity, as well as all sorts of complications, notably empyemas and pericarditis, and others too numerous to mention. At the date of writing (October 1st) "influenza" is already wreaking havoc in some of the cantonments and has gained a foothold in others. It matters very little, in one sense, whether this is the true influenza produced by the bacillus of Pfeiffer or whether it be a pneumococcus and streptococcus infection. From the standpoint of prevention the measures to be taken are substantially the same, leaving out of consideration any possible specific treatment which may be found useful.

I will offer no apologies whatever for taking as my subject, then, the prevention of the communicable respiratory diseases, as this applies to a cantonment such as the one at which I am now serving, *i. e.*, Camp Greenleaf. In a general sort of a way Camp Greenleaf presents identical problems with the other cantonments, in that it represents a large cantonment, roughly of 30,000 men. It presents a more difficult problem than some others in that these men, all belonging to the Medical Corps, come and go with great rapidity. They come in fresh from civilian life, are provided with clothes, taught the rudimentary points of "soldiering" in one division of the camp known as the detention camp, because here they are detained only during the period of incubation of the commoner diseases—*i. e.*, approximately two weeks—and from here they are sent to other parts of the camp through the medium of what is known as the replacement group, from which they are sent to make up the personnel of field hospitals, ambulance companies, evacuation hospitals, base hospitals, hospital trains, etc. In other words, the first two weeks of their stay in camp they are simply divided up arbitrarily, and during this time they are given their prophylactic inoculations, are vaccinated, but are not formed into

permanent units. Company 1 in the detention camp may be ultimately divided into a number of parts, a few men going to one organization, a few to another. Camp Greenleaf consists at the present time of five different groups in addition to General Hospital No. 14, which forms the sixth.

To give any sort of idea of the difficulties of the task which I am discussing it is necessary to say a few words about the housing conditions. In Section "A" we have the medical officers quartered in barracks, some especially constructed for them, others taken over from the Eleventh Cavalry, which is still in part in the park. The detention camp where the men first arrive consists partly of tents and partly of horse sheds which have been converted into sleeping quarters for the men. These sheds consist of long, low structures with a central partition, the individual stalls having no partitions, but merely a bar between each group of two animals, so that we have two rows of animals facing each other with a partition between them. When these sheds were converted into quarters nothing further was done to them but knock out the feed boxes and knock down the flimsy bars indicating the double stalls. The tents are the ordinary pyramidal tents in common use. In other sections of the camp the men are housed to a considerable extent in barracks, but a great many in tents.

Now let us try to state the conditions of the problem clearly. A large number of men are suddenly sent into the camp, perhaps 6000 or 7000 in a week. These men arrive in contingents sent by a certain draft board and arrive at Lytle, several miles away, at any time of the day. Here they are met by officers who check up their number, march them to the camp, where they are taken at once to the detention camp proper. Here they receive their clothing and obtain their first insight into army life. The next day their baggage is shipped home and the civilian of yesterday is today a full fledged soldier, but hopelessly green in every respect. These men bring in with them, as a matter of course, a considerable amount of disease. It is impossible to find 6000 or 8000 men anywhere without some one of them being in the incubation period of some infection.

Now that is just exactly what happens with the arrival of these men in camp. A number are, at the time of their arrival, already infected with the causative organism of some infection or other which will break out shortly after their arrival in camp. Inasmuch as the majority of the commoner communicable diseases would show within fourteen or fifteen days, the period of detention is set at this, and when this period is passed the new recruit is ready to be sent to another portion of the camp to join a definite organization. The problem now is to take this great throng of men, coming from any number of different states, to induct them into a life entirely new to them, to put the men on a diet entirely strange to them, to separate them from home and friends, to teach them drill and the various other things which a soldier must know, and still to maintain them in good health. The point which I have tried to make clear to you in this very brief sketch of a cantonment is that handling these diseases in a well-ordered home or in a well-appointed hospital, especially one with especial wards for contagious diseases, is one thing, and handling these cases in tents, barracks, and converted horse-sheds is quite another, and a vastly more difficult situation. Now remember, if you please, that the army is primarily concerned with the prevention of disease. A well soldier is an effective, a sick soldier may or may not be, later on, an effective. This is, of course, reflected in the weekly reports issued from the Surgeon General's office showing the disease incidence and the rate of non-effectives.

With these preliminary remarks, let us take up in general the diseases already referred to as the communicable respiratory diseases, and let us discuss the measures which are being taken for their prevention to see whether these are adequate and what we may expect of them. Are we likely to see in the immediate future a reduction in the incidence and mortality rate of these diseases comparable with that which has occurred in the communicable intestinal diseases? Let us ask ourselves how these diseases are spread. So far as our present knowledge is concerned, they are spread by the transmission of the infective secretions from the air-passages of an infected individual, and we may

distinguish both direct and indirect infection. Chief among the sources of direct infection is the so-called "droplet infection." It is not necessary here to recount the many researches which have been made along this line, especially in connection with tuberculosis, but the general proposition may be succinctly stated by saying that in talking, coughing, singing, and sneezing droplets carrying the infective organism are transmitted directly from one person to another. In my lectures on this subject I am accustomed to call attention to the importance of immediate proximity as bringing about infection by a comparison with a law governing the intensity of light. If a given candle or other source of light covers an area of 1 foot on a screen 1 foot removed, it covers 4 square feet of this screen at a distance of 2 feet, 9, at a distance of 3 feet, 25, at a distance of 5 feet. In other words, the intensity of light varies inversely proportional to the square of the distance. In a rough way this is true of the liability to infection from droplets. A given number of droplets projected in more or less straight lines in coughing or sneezing radiate as the rays of light do, so that an individual at a distance of 5 feet will receive on a given area only one-twenty fifth of the number which he would receive at the distance of 1 foot. I know of no more striking way of emphasizing the importance of crowding, whether this be in barracks in mess halls in places of public assembly, or what not. To make sure that the authorized number of men in the barracks is not exceeded, the number is plainly stenciled on the outside of the building, and this number must not be exceeded. In the army I should rank overcrowding as possibly the most important single factor in the transmission of this disease. Now we must reflect that overcrowding in the army is likely to be a matter of much more common occurrence than in civil life, for the reason that the exigencies of warfare do not always admit of having hygienic conditions all that they should be.

Indirect transmission is, of course, nothing more or less than the transmission of these same droplets from the sick man to his well neighbor in an indirect manner. When one stops to think of the very many ways in which this can be

brought about, one marvels not that the cases spread at times with great rapidity, but that any individuals remain uninfected. A man blows his nose on a handkerchief, perhaps many times in a day, and almost inevitably soils his fingers in so doing. It does not occur to him that when he shakes hands with another individual he may pass on the organism of this disease to his friend, who, in turn, handles something which goes to his mouth and gets the organism into his system. If the individual is a cook, handling articles of food, the same transmission may occur. Whether or not clothes, etc., may carry the organisms of these diseases is a debated question. It seems to me that we must occupy a conservative position, somewhere between the Scylla of believing that fomites are an important factor, on the one hand, and the Charybdis of believing that they are of no importance on the other. Where men are herded together in close proximity, all coughing unrestrictedly, it might very well be that their clothes become more or less contaminated with the droplets and that these, in turn, serve as a mode of conveyance when the droplets have dried. That this is a factor of very great importance, especially with a short-lived organism as the Pfeiffer bacillus, may well be doubted. The transmission of scarlet fever and the streptococcal infections by means of milk is, of course, familiar to you all, but this plays a relatively unimportant rôle in the army, because of the wide use of condensed milk.

Unfortunately, until we know the precise nature of the organism causing, for example, measles, until we know its cultural peculiarities, we can only speak of measles by analogy. In the case of influenza we know that the organism is relatively short lived and that the disease has a very high degree of infectivity, the Pfeiffer organism being constantly present in the respiratory passages in the true cases. It may well be, because of the difficulty of growing it, that it is not always obtained in cultures, even when it is present in large numbers. This short summary embraces, unfortunately, nearly all that we know on the subject of the exciting causes of these diseases. We come now to the discussion of the carrier, a subject about which a considerable controversy is being indulged in. At the

present writing many men emphasize the importance of the carrier, a considerable number are skeptical as to its importance. It seems to me that until the causative agents of all these infections are very thoroughly known, we are not justified in omitting any precaution looking toward the elimination of the carrier. Now with these facts in our mind, let us take up the measures which may be taken and which are being taken in this camp to prevent their spread.

To begin with, an isolation camp should be established, *preferably in tents*. At Camp Greenleaf we have one for each section of the camp because of the extreme difficulty in obtaining a site for a single camp large enough to take care of the cases from all sections. These camps are of sufficient size to admit of an expansion to a maximum of 8 per cent. of the command of that section. Each camp is under a commissioned officer, and every suspected case of acute respiratory disease except meningitis and pneumonia is sent to these camps, unless, in the opinion of the Camp Surgeon, their condition, when first seen, is of sufficient gravity to warrant direct transfer to the hospital. In a case of meningitis or diphtheria, cultures are *made as soon as possible in every case* admitted to the isolation camp. A most important matter relates to what cases are to be sent to these camps. In meningitis and diphtheria the entire company or organization is promptly quarantined in this camp until the carriers are found and removed, which means that the organization is quarantined until the result of the cultures is had from the laboratory, *but no longer*. To a civilian physician an isolation camp of this sort is a decided novelty. Picture to yourself rows of pyramidal tents, with a guard thrown around them, divided up into sections, when necessary, for the different diseases, the men eating out-doors, for the most part, or in their own tents. They are allowed to mingle out-of-doors, that is, they may take a short walk together or stand around out-of-doors or even do light work to a certain extent, but mingling indoors, especially visiting from bunk to bunk, sitting around on each other's bed, is strictly prohibited. In the conduct of such a camp it is highly important to bear in mind that

certain predisposing factors are important in assisting the organisms of the disease to take hold. We refer particularly to fatigue, wet feet, insufficient nourishment or clothing, and similar factors. Every precaution is taken to give the men a moderate amount of exercise, never carrying this to the point of fatigue. Every effort is made to have them warmly covered at night, to see that they have a sufficiency of good warm clothes and to avoid wet feet, the latter of which, especially in the winter time in the South, is no simple matter. Now, it is to be emphasized that this isolation camp is a very different affair from the civilians' idea of a quarantine camp. For example, if, in a company barracks containing, let us say, 150 men, a case of measles breaks out, we send that case of measles to the hospital, or if it is only a suspicious case, to the isolation camp, but we do nothing in the way of a quarantine with the rest of the company, except that we may isolate a man or even two men on each side of the measles patient. The propriety of this isolation of contacts is doubtful, and while we are doing it in some cases, it is questionable whether it will be kept up. The only diseases for which we quarantine are, therefore, meningitis and diphtheria, and these only for the few days which must elapse before the laboratory reports can be had in the cultures, which enables us then to return the carriers and send the rest of the company back to duty.

The next most important point consists in doing everything possible to prevent indiscriminate coughing, especially where men are congregated in large numbers. This is a matter, of course, of great difficulty. Foreseeing these conditions, a general order (G O 84) was issued on September 24, 1918, from which I shall freely quote, since it represents in a nutshell much of our knowledge in this matter. One provision of this order is "particular attention will be paid to the prevention of promiscuous coughing and sneezing, much of which can be controlled. Indoors, coughing and sneezing must be done only with the handkerchief held over the mouth and nose to prevent spreading of infectious material. Offenders in this respect will be disciplined." Personally I have felt, as undoubtedly many others

do, that there is scarcely any point in which the ordinary deficiencies of life are so frequently outraged as in this respect. People cough indiscriminately, and while the public at large has a vague idea that the consumptive should not be allowed to cough without protecting his neighbors, it has practically no sort of idea that when indiscriminate coughing is indulged in it is a swift and sure means of spreading each and every one of these respiratory infections. Taking then the paragraph in the General Order which I have just quoted, let me impress upon you that there is one thing which we can do and which we do not do, and that is to put an end to indiscriminate coughing. One distinguished surgeon in this camp enforces the rule in his wards by making every one, officer or enlisted man, who is detected coughing without protection of mouth and nose by a handkerchief wear a gauze mask for the rest of that day.

It is clear that if the droplets are received in a handkerchief and the infectious secretions from the nose are similarly received the handkerchief becomes a highly potent source for the transmission of infection. Recognizing this, the same general order goes on, "handkerchiefs used by persons with acute respiratory disease are highly contaminated and may be dangerous as agents in the spread of disease. Outdoor laundries used by the men will be provided with galvanized iron cans suitably mounted on brick work, filled with boiling soapy water and under which fire will be maintained between daylight and dark. All handkerchiefs washed in outdoor laundries will be boiled therein for five minutes before washing. The Sanitary Officer will insure that all clothing washed outside the reservation by private parties is sterilized by boiling." (All laundries in this camp and all washwomen have been inspected from time to time and a card index of those found satisfactory—i. e., those who boil the clothing properly—is kept constantly up to date.)

The individual cooking outfits of the men are treated likewise. "All individual mess-kits will be washed by their owners in three separate waters, each of which will be boiling at the time of use. All knives, forks, spoons, and cups in public or

private messes will, after washing, be immersed in boiling water. Drinking glasses will similarly be placed in cold water, which is then to be raised to boiling. Organization commanders will give their personal attention to the enforcement of this requirement." The use of the common drinking-cup, it is hardly necessary to say, is strictly prohibited.

One of the greatest problems which confronts us in the handling of these diseases is what to do with the Y M C A buildings, hostess-houses, K of C buildings, and other places of public assembly. These places are virtually clubs for the enlisted men, and the morale of the camps is immeasurably higher since these agencies have been at work than it was before they existed. They offer places where there is good light, good entertainment, and good company, and without a great detriment to the morale of the camp they could not be closed. We are handling the situation as follows. The windows are kept open, *wide open, all the time*, and efforts are being made to secure increased heating facilities so that this may be possible with the advent of cold weather. It will hardly be possible in the event of high winds and zero weather to carry this out literally, but the effort is being made to make them practically so well ventilated as to *approximate outdoor conditions*. The restriction as to coughing is, of course, rigidly adhered to. The importance of dust in the causation of these diseases, especially pneumonia, has been emphasized by many writers. It was the consensus of opinion that its rôle is a very definite one, although it is not at all certain that the actual organisms are necessarily carried by it, at least out-of-doors. Here it probably acts as a predisposing factor only, preparing the way for the causative organism by producing mild inflammatory changes. Indoors, especially where ventilation is deficient and the sun has little access to the room, it seems probable that the organism itself may be thus transmitted. Recognizing that dust plays a certain rôle, even though this be a subsidiary one, no dry sweeping is permitted, all floors being swept daily with damp saw-dust, and are then mopped with a suitable disinfectant solution. In addition to this, all floors which are, of

course, of wood, are thoroughly oiled with a mixture of crude oil and kerosene to prevent dust. We have even gone farther, and where, under compulsion of military demands for increased accommodations, it has been necessary to use stables and sheds with earthen floors, these have been oiled in a similar manner to keep down the dust.

An exceedingly important point and one which, alas, is but little heeded in civilian life is not to overheat the dwellings. The temperature of the barracks is not to exceed 65° F. I have believed and taught for many years that the sudden changes of temperature to which people are subjected in going from overheated rooms directly out-of-doors is a predisposing cause of some importance. In addition, the hot dry air, drying up the nasal secretions, must reduce the tone and resisting power of that mucous membrane in a very marked degree.

Hand in hand with this ventilation during the daytime goes the ventilation of the sleeping quarters. This is accomplished in the following manner: "Alternate windows on both sides will be kept open each night in all barracks after taps, except that on stormy nights all windows open on the side opposite the wind and the windward side will be closed. All tents will have their door flaps tied back to their full extent at night." During the day ventilation is adequately provided for by requiring all doors and windows of barracks to be kept open during drill periods and during the meal hour. In the case of tents, all these are furled or struck frequently, weather permitting, and they too have their walls looped up during the drill hours in fair weather, and it is forbidden to close any of the ventilating openings except to keep out rain. In other words, every precaution is taken and rigorously enforced to see that the most thorough-going ventilation, in a way utterly unknown in civilian life, is brought about. As a further precaution Officers and men in tents or barracks will sleep alternately head and foot to diminish transmission of infection through coughing and sneezing.

Recognizing the possibility of transmission of infection by fomites, it is required that "all bedding and clothing will be sunned and aired in the open air for at least two hours, three

times weekly, weather permitting It will be spread out or exposed on lines, tent frames, or cots, as much as possible to get the full effects of sun and air "

One measure is carried out religiously in the service which is unknown in civilian practice, *i e*, careful daily or twice daily inspections During the period of time which the men pass in the detention camp, that is, during their first fourteen days in camp, a careful examination is made of them, stripped to the waist, morning and evening, paying especial attention to the eyes, nose, and oral passages, and, of course, to the skin, with a view to detecting any eruptive diseases If the man seems sick or if his pulse be rapid, the temperature is taken, and if found to be over 101° F he is promptly isolated This means that a man showing a temperature of 101° F is presumed to have some infection, even though there is no other objective evidence of it, and he is therefore isolated on the presumption that this infection may be of a communicable nature Now it should be carefully noted that these cases are not singled out to go to the hospital at once, and this for two reasons A great many of these cases turn out to be merely "common colds" and similar relatively trifling maladies which can be handled just as satisfactorily in the isolation tent camp as anywhere else The second reason is that it prevents transferring the soldier out of his organization into the General Hospital and overrunning this with cases not sick enough to imperatively demand hospital treatment

The management of a quarantine tent camp requires a considerable degree of resourcefulness and particularly good judgment To begin with, as soon as it attains any size, it must be administered in zones That is, meningitis contacts and carriers may be in one zone, the diphtheria in another, measles in another, etc I cannot lay too much stress upon the importance of detecting these respiratory conditions at the earliest possible moment, since it is just in this condition that they attain a very high degree of infectivity The detection of the cases early and their prompt isolation are the two keynotes of successful management This applies particularly to the mild cases, since they are especially likely to be overlooked and to go about spreading infection in their path

To sum up the matter, we may say that the prevention of communicable respiratory diseases is as yet in its infancy. They are spread by overcrowding and constitute the typical "crowd" diseases. All the various means of spreading the infectious material from the nose and throat are operative in their spread. Promiscuous coughing and sneezing, dry sweeping, which raises clouds of infectious dust, sitting around on beds, the clothing, which may have been contaminated by infectious nasal secretion, are all prime factors. The predisposing factors are much the same as for any other disease, particularly fatigue, great mental depression, insufficient food, and chilling of the body by wetting may all be mentioned. Particular emphasis should be laid on dust, since, even if it be not itself the carrier of the disease germs, it acts as an irritant in a very definite fashion. This may, perhaps, seem strange to the doctor of a well-ordered municipality where dust is scarce, but to anyone who has seen the dust storms of the West and South this fact needs no urging.

Our preventive armamentarium consists of fresh air at all times and in all places in maximum quantities with, of course, adequate clothing. The maximum amount of outdoor life in the sunshine should be insisted on. The early detection and removal of suspicious or slightly infectious cases to a properly administered isolation camp, the systematic and careful culturing of appropriate cases, the disinfection of the handkerchiefs, mess-kits, and other eating utensils, allowing mingling freely out-of-doors, but none indoors, are matters of great importance.

Lastly, there is one thing which everyone of my readers may learn from the army, and that is, how much can be accomplished by *simple measures provided these be efficiently carried out*. In an organization where the discipline is good and the measures just mentioned can be enforced under penalties of discipline, even the simple means just enumerated should go far toward keeping down the incidence of this type of disease, even when it is so contagious as measles or influenza. In other words, a few simple measures efficiently carried out are more likely to prove of value than elaborate quarantine and other measures carried out in a half hearted and slipshod manner.